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Engineering News-Record

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Storm-Tide Hazards at New Orleans

Water for Hendersonville, N. C., from Pisgah National Forest

Methods of Controlling Traffic in the Oakland Estuary Tube

Improved Field Equipment for Determination of pH

Method of Laying Rock Asphalt in Cold Weather

Excavating a New Channel for the Chicago River

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Volume 102 NEW YORK, MAY 2, 1929 Number 18

Combating Destruction

STUDY of insect damage to wood construction in tropical regions, recently begun anew by the National Committee of Wood Utilization, represents a further praiseworthy attack on the problem of eliminating preventable losses. This source of deterioration has long been known and has been fought in many ways, but it calls for a more effectively united effort than has yet been applied to it. Theoretical knowledge of preventive methods is not lacking, though doubtless it can be much improved; but the more pressing problem at the moment appears to be that of practical application. It is necessary to make the available remedies so widely known and appreciated that they will find application on a scale commensurate with the seriousness of the trouble. The objective is not the mere saving of wood but giving the constructor in tropical regions a wider range of materials or construction types to serve his various needs. Both the resources of the engineer's art and the economic value of its applications are increased by any increase in the range of materials and methods available for his work. The solution of the present problem therefore will have a value to tropical progress well beyond the money value of the material at stake.

Reconstructing Society Work

A DISTINCTLY novel event in the rapidly evolving field of engineering societies is the American Concrete Institute's attempt at radical reconstruction of committee work, details of which were announced recently. During the quarter-century since its founding this organization, like many other societies, had set up a large number of technical committees, each dealing with a specific problem or field. Since such problems naturally grow out of the random requirements of the art involved, they seldom result in a system of committees which will fit into an ideal scheme or a rigidly grouped classification. Indeed, practical facts always are apt to be disdainers of categories or academic schedules. The governing authorities of the A.C.I. have now undertaken to departmentalize the whole committee system of the organization on the basis of an ideal scheme, even though to do this they had to wipe out all the existing committees and start with a clean slate. The attempt is courageous, for it is no small matter to interrupt or paralyze a society's essential work even temporarily. But the case is more interesting because of its relation not only to the future of the A.C.I. but also to the situation of all technical societies today, since all of them alike are facing a demand for more production service to their groups. As to the effect of the reorganization upon the A.C.I. itself, the controlling point is that not only committee work but the very efficiency of a society are functions of the enthusiasm of the members, and do not depend vitally upon the logic of the organizational scheme. Accordingly, the test of the new plan is whether it can maintain and invigorate the spirit already within the society and elicit full co-operation of its growing membership. If it can, it will set a high model for other societies.

Carbon Monoxide

CARBON MONOXIDE always has been given a great deal of consideration by those who design ventilating equipment for vehicular tubes. As the art of tube building has advanced and there has been experimentation with new features of design, this colorless, odorless gas has caused ventilation engineers much anxiety. There is no discounting its serious effects when breathed even in highly diluted quantities, but in the light of experience in the Oakland estuary tube, described elsewhere in this issue, it would appear that there has been at least some unnecessary worry about CO. That is, experience at Oakland indicates that so long as the ventilating equipment renews air in the tube at a rate sufficient to keep oil and gasoline fumes from becoming offensive in the form of odors or as a haze of oil smoke, the CO content will not approach the permissible limit of four parts per 10,000. In other words, while CO itself cannot be detected by eye or nose, under conditions obtaining in a vehicular tube both these senses will give warning of unpleasant gasoline and oil vapor fumes long before the CO content rises to the danger point. This is reassuring to designer and motorist alike. It suggests the possibility that if the Oakland experience is borne out by operation over a longer period and is checked by results elsewhere a new criterion may be adopted for vehicular tube ventilation—that is, CO gaging would become merely a check and the actual basis for determining the rate of air change would be the amount of oil and gas vapors that may be present without offense to keen eyes and sensitive noses.

A Dredging Improvement

CHANNEL dredging at Chicago as described in this issue presents a novelty in the device which enables hopper barges to be loaded by hydraulic dredge. Normally in hydraulic dredging the need for transferring the spoil to barges for disposal does not exist. Exception is noted of harbor dredging using self-propelling dredges pumping to hoppers in their own hulls. Trans-shipment, too, besides being an extra cost is mechanically troublesome. The velocity of discharge and the limited stilling pool area afforded by the hoppers result in great waste in the overflow. It is to overcome these two obstacles that the discharge or loading scow equipment used on the Chicago channel work was devised. By a division and a change in direction of the discharge and by an increase in pipe diameter, the nozzle velocity is reduced and the stream flow is directed so as to assure the greatest stilling effect possible before the water overflows the hopper

edges. At Chicago the device has met a special condition successfully. The more important fact however is that it widens the horizon of usefulness of the hydraulic dredge.

Sewage Association Progress

DEVELOPMENT of better operators and better operation of sewage-works is fostered by the organization and subsequent activities of sewage-works associations. The newest of these, covering New England, got to work at Hartford last week. On May 4 one for New York State is to be organized at Albany. A few weeks back, the New Jersey Sewage Works Association, pioneer in this field, had a strong meeting at Trenton. Quite recently the California Sewage Works Association, organized less than a year ago, held a meeting with a registration of 120 and reported a membership of two hundred. Altogether, ten or a dozen of these associations, some covering water as well as sewage treatment, are in existence. While designed primarily to aid the sewage-works operator in gaining a better knowledge of his daily work they have attracted many other classes. At the California meeting half of those in attendance were city and county officers who came to learn what a sewage treatment plant is expected to do and how it can be bettered in the efficiency of its capital investment and operating charges. Every such official, as well as the operators themselves, goes back to his city with a new determination to get the best possible out of the local plant. Engineers in private practice and in the state health service get in closer touch than before with the operators and their problems. There is a valuable get and give all round. The movement means betterment of the public service.

Strengthening the Profession

RESIGNATION of two members of the Engineer License Board of New York State draws attention to the general unsatisfactory status of licensing in many of the states which have engineer license laws on their statute books. In all but a few states—as pointed out by C. J. Ullrich, in his review of licensing in *Engineering News-Record*, Feb. 7, 1929, p. 229—the licensing boards have made no active efforts to give real protection to the public and to the profession against those who would flout or violate the law. It is becoming quite apparent, however, that vigorous enforcement is now in order if the very purpose of licensing—namely, to build a sounder professional system—is not to be destroyed. This matter of enforcement is to some extent involved in the present misunderstandings within the New York Board of Examiners. Heretofore, the board has merely examined and licensed, without taking aggresive steps toward enforcement. One fortunate phase of the matter is that, though engineering corporations at first were strongly opposed to the licensing system, many of them have now come to see its virtues and make voluntary use of it even where the law exempts them from its action. Other corporations remain unconvinced and either passively or actively oppose the law. Yet if the licensing system strengthens the profession by fixing minimum standards, it will thereby be of benefit to engineering corporations. This, we believe, is true not only of civil engineering but also of such specialties as mining and electrical engineering. But if we assume for the present that these latter professions have no interest in licensing, it might be better to eliminate all but civil engineers from the operation of licensing laws rather than paralyze or destroy the system entirely. Protection of the public interest is a paramount objective, and civil engineers more than other engineering groups are concerned with public service in matters affecting the safety and well being of a community.

Chances of Disaster

COMPARED with bygone ages the modern world is distinguished by a prodigious development of man's power over nature. Not only do we utilize its beneficient forces but we combat and in a great measure overcome its harmful ones. Safeguarding against accidents and overcoming the sweep of epidemics are among the highest activities of the present generation. Yet formidable problems still remain. Hurricanes and tornados bring forth some of these problems. Among them is the hazard of storm tides, which command present attention because of the destruction wrought by them at Lake Okeechobee twice within the past three years.

Great storm tides, rare and obscure phenomena, are among the most terrifying forms of disaster. Are they so rare that men may ignore their possibilities, or so powerful that it is useless to seek protection? These questions address themselves insistently to modern engineering skill. If there is any hope of favorable answer, it is in order to discover the hazards and plan protection before the disaster strikes.

Far back in the middle ages the sea in its wrath tore the shore line of Holland to pieces and reclaimed for the waters great reaches of fertile country. That happening hardly seems to belong to the modern world, it is true, and we do not know whether wave attack or storm effect was the larger factor. But two dozen years ago, when a great wave driven by a Gulf hurricane swept over Galveston, it was a true storm tide. With its tremendous devastation this disaster seemed to stand quite alone among the world's experiences; there was only one Galveston, everyone felt, and nowhere else need the like be expected. Then in 1926 a hurricane threw the water of Lake Okeechobee ten feet over the town of Moorehaven, a new demonstration of what may result from this particular action of nature. But it was something that in this particular region was unprecedented, and therefore would never recur—for these are the hopeful conclusions that human faith inevitably reaches. The dikes were rebuilt and all was confidently made the same as before. Yet only two years later the disaster was almost identically repeated; the storm tide, this time overwhelming Belleglade, a few miles away, placed thousands instead of hundreds on its roll of death.

Okeechobee's impressive demonstration of storm tide possibilities is clear warning of the fact that if the great hurricanes of the Gulf can expose other regions to similar hazards, the danger should be discovered in time. Do the shallow waters of Lake Pontchartrain, at the back door of New Orleans, contain the threat of storm flood danger to the southern metropolis? Such a question demands answer. The city is within reach of the hurricane's tracks; its lakeside areas are low and weakly protected. What could happen were the storm wind by chance to take a direction which would duplicate the Florida events? After Okeechobee these questions are virtually inescapable.

A. M. Shaw's study in this issue of this potential hazard is the outgrowth of questions raised by the editors of *Engineering News-Record* just after the Florida dis-

aster of last September. The two lakes are commensurate in size and character, and though Florida is far closer to the breeding zones of the great Caribbean storms, the New Orleans region has often felt some of their fury, and for all we now know may some time be struck in undiminished strength. The values at risk are incomparably greater than in the Everglades. How real, then, is the hazard and how imperative the planning of adequate protection?

The answer, as set forth, falls short of being conclusive. It does not prove the existence of danger convincingly; but much less does it give any substantial reassurance that a hazard is absent. Broadly, it is a warning of most significant character—a warning whose meaning may not appear in centuries, but might possibly be spread on the record of great accidents before the present year is over.

We may justly recall at this time that storm and flood are not like the seasons—they do not come at appointed times, but descend upon the earth unheralded. Though they be extremely rare, we cannot depend on their long intervals; the only safe way is to think of them as events of tomorrow.

Let it be also remembered that if former ages with their lesser wealth and fixity of human works could tolerate occasional destruction of a countryside or a city, the world by now has grown too full and too interdependent to permit a light disregard of great destructions. Our present-day obligation is to protect and conserve by applying engineering skill and labor to protection against discoverable hazards.

Railroad Consolidation Plans

NO RAILROAD consolidation plans must be initiated without first obtaining the consent of the Interstate Commerce Commission. That, in effect, is what the commission says in its recent finding that the New York Central, the Nickel Plate and the Baltimore & Ohio violated the Clayton anti-trust law in acquiring 17 per cent of the stock of Wheeling & Lake Erie Railroad. It matters not to the commission whether it may in the future assign the Wheeling & Lake Erie to one of the three roads which it now finds violated the anti-trust law by controlling a line with which they compete. When that time comes its findings that such control is proper under the provisions of the transportation act will, it appears to believe, automatically remove the railroad named from the classification of violators of the anti-trust law into which it now puts it.

Under the transportation act as now written the commission is supposed to have prepared and published a plan for the consolidation of all the roads of the country into a few large systems. It has never done so, and as the transportation act did not forbid the transfer of control of railroad properties until such plan was announced, the railroad companies have continued to strengthen their individual positions by acquiring partial or complete control of other railways whenever opportunity presented itself. When such control became so effective as to require the commission's approval it was asked for, but often, as in the W.&L.E. case, it was not needed.

A majority of the commission has for some time frowned upon this method of handling consolidation, but it has not been able to put an effective check upon it under the transportation act. Now it appears to have found an added means of enforcing its will upon the railroads, the anti-trust law.

The possibilities for evil in either method of obtaining control are apparent. If one railroad goes to the commission with its plans before making any move to get control of another railroad which it desires, the stock of that road immediately is given fictitious speculative value, so much so that its purchase price may become prohibitive. On the other hand the private unregulated exchange of control of railroad properties may—as appears to be the case with the W.&L.E.—keep a weaker line from acquiring a line which it needs in order to enter more keenly into competition with its larger competitors. As between the two, the latter appears to be the more desirable, because there is nothing to keep the commission, when it does get down to laying out a limited number of systems, from assigning the W.&L.E. or any similiar road to the system in which it believes it rightly belongs. Meanwhile stocks of the smaller key lines are kept from speculative manipulation.

A Mistaken Goal

IN RAPIDLY growing arts and industries, pervaded as they are by cheerful optimism, unfavorable factors are apt to develop unnoticed or even to be misjudged entirely and considered as signs of healthy growth. A situation involving the latter possibility was apparent at the annual meeting of the American Welding Society last week in so far as structural welding was concerned. At no previous meeting has more substantial progress been recorded, yet as part and parcel of the general tone of the meeting there was evident a guarded desire for standardization. Both in the papers and the discussion such phrases as "standardized practice," "standard connections" and "welding standards" occurred. This is a dangerous mood, made none the less dangerous because some admitted that the welding art is not yet ready for standards. Indeed it raises the question whether standardization is ever a goal to be desired.

For the welding art, standardization is a mistaken objective at the present time. It is true that modern industry attributes much of its success to standardization but the process holds no advantage for a developing art. The history of attempts at standardization in the concrete field contains a valuable lesson for the welding fraternity. Today, after more than a quarter century of growth, ideas of concrete making are undergoing vast improvements, and yet there were those who wanted to standardize concrete design and construction on the narrow and uneconomical basis existing 15, 10 or even 5 years ago. Fortunately, the majority realized the pitfalls of such action, and concrete stands today on the verge of a more effective and vastly greater usefulness than it has ever enjoyed before.

As with concrete so with structural welding—its hope lies in maintaining an open mind to change, which is synonymous in effect to developing a definitely negative attitude toward standardization. The future of structural welding rests in the hands of the young engineers just now or soon to enter the profession whose minds are unencumbered with a generation of growth of riveting precedents. It would be unfair to them to decorate any door to welding progress with a "Keep out—standardized" sign. No more effective bar to progress could be erected. It is earnestly hoped that all thoughts of standardization in the welding art will be put aside so that the growth now so auspiciously begun can continue unhampered.

An Estimate of Storm-Tide Hazards to New Orleans

With Different Courses Gulf Storms of the Past Would Have Inundated New Orleans—Future Storms at Any Time May Take These Threatening Courses—Against Them New Orleans Is Ill Protected—With Millions Spent to Keep Out the River, Little Has Been Done to Resist Gulf Storm Tides

By A. M. Shaw
Consulting Engineer, New Orleans, La.

STORM tides present a continual menace to habitation and engineering structures along the whole Gulf coast from Key West to the Rio Grande. Their manifestations of destructive power at Lake Okeechobee in Florida in 1926 and 1928 are still fresh in memory, and the Galveston storm of 1900 is historical among natural disasters. Only because they did damage to remote railways and bridges in a wild territory were the storms of Sept. 20, 1909, and the two storms of 1915 (Aug. 17 and Sept. 29) unrecorded as calamities. Indeed, had a vagary of cyclonic fury swung the path of the last-mentioned storm a shade to the east there might have been recorded at New Orleans another tragedy of nature. And tomorrow, or not for years, a tornadic wind may sweep up from the Caribbean and drive an inundating storm tide ahead of it.

As the largest American city directly in the path of tropical storms New Orleans has been naturally the focus around which gulf storm-tide studies have concentrated. It therefore enters the field of prime consideration here where engineering protection against storm tides on the Gulf coast is in review. That the writer may not be charged with spreading alarmist propaganda attention is directed to the reports of the sewerage and water board of the city, in which its flood hazards from the north and west have been repeatedly indicated. There is no implication of flood danger in this article which has not had positive expression by the city's own engineering advisers.

The maps Figs. 1 and 2 show the water and marsh areas surrounding New Orleans and the levee system which has been provided. In rough approximation New Orleans within its levees, Lake Pontchartrain and the marshes, low water in the Mississippi River, and mean water in the Gulf are at the same elevation.

A profile of the city, lake and river levels is shown by Fig. 2. The city is drained by pumping stations which discharge into tide-level outfall canals, three of which are leveed and lead through drained areas into Lake Pontchartrain and are from 2 to 2½ miles long, and

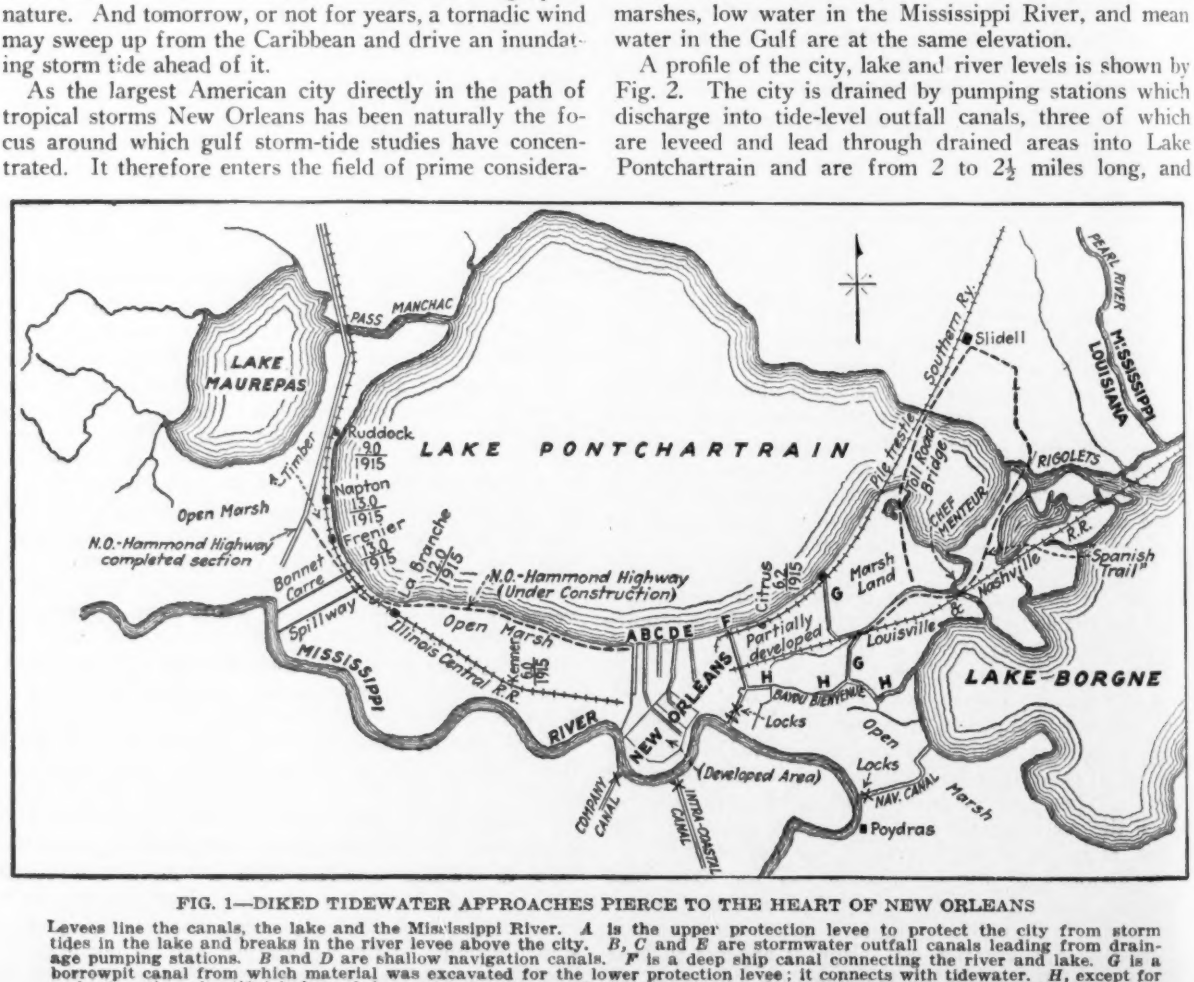


FIG. 1—DIKED TIDEWATER APPROACHES PIERCE TO THE HEART OF NEW ORLEANS

Levees line the canals, the lake and the Mississippi River. *A* is the upper protection levee to protect the city from storm tides in the lake and breaks in the river levee above the city. *B*, *C* and *E* are stormwater outfall canals leading from drainage pumping stations. *B* and *D* are shallow navigation canals. *F* is a deep ship canal connecting the river and lake. *G* is a borrowpit canal from which material was excavated for the lower protection levee; it connects with tidewater. *H*, except for a short section of artificial channel, is a natural waterway, Bayou Bienvenue. It is the main drainage outfall and carries into Lake Borgne all but excessive storm drainage. None of these canals has a controlled entrance to tidewater, making it necessary to maintain side levees against storm tides in both lakes.

another of which leads into Lake Borgne, 14 miles away, through a tide-level section which has never been drained. As a broad summation New Orleans has water hazards on all sides and is safe only behind levees. With this in mind, the consideration of storm-tide hazard can be taken up.

Great storms do not occur with any regularity, nor with great frequency in any given locality, but their recurrence is sufficiently within the range of possibility to make it incumbent on the engineer to provide for all conditions which may reasonably be expected. Along the shores of the Gulf of Mexico from the Rio Grande to the Mississippi line there are practically no lands which are above the highest floods caused by tropical hurricanes, while the Mississippi, Alabama and Florida shore line quite generally is backed either by similar areas or by lands only slightly above flood level.

Definition of Storm Tides—In discussing conditions accompanying great storms along the seacoast, there frequently is an incorrect use of such terms as *tidal waves* and *storm waves*, but the term *storm tide* more nearly describes the high-water conditions accompanying such storms. The following description of a storm tide is quoted from the recent book "Tropical Cyclones," by Dr. Isaac M. Cline, principal meteorologist, U. S. Weather Bureau:

> It is a cumulation of the water from successive "storm waves" reaching shore, covering a period of two or more days, with a gradual rise which increases as the storm approaches. The "storm tide" results from the physical forces of the hurricane driving the large waves forward and transferring the water in the same direction as the line of advance of the hurricane.

The operation of the *regular tides*—that is, the diurnal or lunar tides—is in no way affected by the storm tides, the influence of the former being observable throughout the duration of the latter, even though this may cover a period of several days.

Origin and Paths of Storms—Tropical hurricanes which affect this country originate in the Caribbean Sea. They occasionally cross Cuba or other portions of the West Indies, but their more favored path is through the Yucatan channel. They have been known to strike the Atlantic coast as far north as Savannah, Ga., but if they get past Florida they usually pass out into the Atlantic without striking land. These storms have a rate of forward travel of from 10 to 14 miles an hour, the rate of travel apparently bearing no relation to the wind velocities within the storm area, which may reach (for short periods) as high as 120 m.p.h. These sudden gusts are a serious menace to buildings and other structures exposed to their influence, but as they are of short duration and thus can have only a secondary influence on storm tides, only mean hourly wind velocities will be considered herein.

The winds of a tropical cyclone (in the Northern Hemisphere) pass around the storm center in a counter-clockwise direction, those in the right segment of the storm area blowing in the general direction of the line of travel of the storm. It is in this segment that maximum wind velocities occur, and their influence on creating tides is much greater and extends for greater distances from the storms center. This phenomenon is indicated by the accompanying map, Fig. 3, which traces the path and indicates the resulting tide levels of three storms of major intensity. The tidal stages shown for the storm of 1909 are principally from my own records compiled immediately after the storm, while those for the two storms of 1915 were taken from a paper on storm tides by C. W. Okey. Supplementary records of each of these storms were secured from the published data of the U. S. Weather Bureau.

Water Transfer by Storm—During the 1915 storm, which centered near Galveston, there was no perceptible rise of tide at Port O'Connor, a point on the Texas coast just beyond the limits of the accompanying map, Fig. 3, and about 110 miles to the left of the path of the storm. On the shore of Marsh Island, about the same distance to the right of the storm path, a rise of 9 ft. occurred. Similar characteristics may be noted in connection with the other storms for which data are given.

That there is actual and progressive transfer of sea water toward the shore—and far beyond, in the case of low-lying shores—is obvious from the study of the effect of these storms. As is indicated by the above quotation from Dr. Cline, we have no reliable data as to the actual rise in the deep, open sea, though it is obvious that it is materially less than occurs along the shore. An indication of this is found in the tide records at Port Eads, near the mouth of the Mississippi River. At this point the alluvial deposit takes a comparatively steep slope, depths of more than 600 ft. being found at points only 10 miles off shore. As a result of the September, 1915, storm, the tide rose at Port Eads a maximum of 3.8 ft., while at the point 30 miles up the river, with a wind fetch of 40 miles across shallow water, a tide of 11.6 ft. was experienced. Such increases in tide height appear to be the result of obstruction to flow over land and shallow basins, though a contributing factor may be the restriction of

A City is Warned

THIS ARTICLE brings to the attention of engineers the increasing fund of data being made available for their use by the study of tropical storms.

Consideration is given particularly to the Gulf coast centering at New Orleans. Conditions in this area are typical; detailed and especially reliable data are available, and the many years' experience of Mr. Shaw in the locality has made it possible for him to draw from his own experience and personal observations as well as from the experience and writings of others.

Specifically the path and resulting tides of three storms of major intensity are traced; possible heights of future storms variously placed are suggested, and the means available for storm tide protection are described.

The facts disclose that New Orleans is wide open to inundation should storm come from another or eastern direction. Canals like sword thrusts extend to the very heart of the city, and they are not adequately kept up. The upper protection levee is even now being squabbled about with the adjoining parish over right-of-way. Levees are 10 ft. high and storm tides only a few miles away were 13 ft. high in 1915.

New Orleans lets the federal authorities spend millions to protect its waterfront by the Bonnet Carré spillway, when a tropical storm of whose direction there is no definite assurance might drown its inhabitants like rats.

Storms do not creep up inch by inch like the rising Mississippi. Breaks in the canal levees are going to occur not in bright sunshiny weather but at the zero hour of a storm advance, when everyone but the vigilant engineers and their staffs are glad to be well housed.

Mr. Shaw is no scarehead writer, but quite definite conclusions can be drawn from his figures and from the map, which indicates that New Orleans except for its fortuitous location with respect to Lake Pontchartrain would have been inundated in the 1915 storms.

These are facts that most engineers in New Orleans realize but of which the people as a whole never think, giving their whole attention to the menace of the Mississippi.

Truly, New Orleans needs to look at its backyard defenses quite as much as at those more spectacular ones on the riverfront.

—EDITOR.

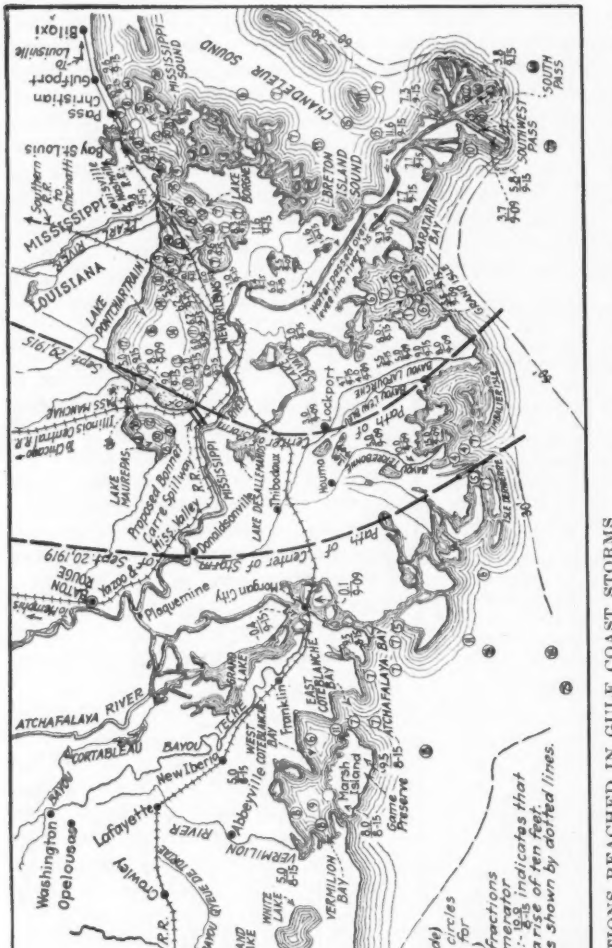


FIG. 3—STORM TIDE ELEVATIONS REACHED IN GULF COAST STORMS
General direction of storm is from the Gulf, but the greatest intensity is on the right segment of the storm area, the counter-clockwise winds here blowing in the direction of travel of the storm.

the undertow which would be present in deeper water and which would assist in maintaining an equilibrium.

An even more pronounced local variation occurred in the tides on Lake Pontchartrain during the September, 1915, storm. Along the west shore, which was subjected to the maximum wind forces, there were obstructions to flow consisting of the Illinois Central Railroad embankment and a heavy growth of timber close to the lake. During the height of the storm a tide of 13 ft. was experienced at Frenier and Napton, while a rise of only 6 ft. occurred at the mouth of Pass Manchac and of only 2 ft. along the front of the city of New Orleans.

The maximum tide on the city front occurred the following morning with the return surge of the water in the lake and a change in direction of the wind. With a strong wind from a generally northerly direction during the following day, the tide along the south shore of the lake remained at 4-ft. stage until the afternoon of Oct. 1, though it dropped to within 2 ft. of normal on the west shore by the morning of Sept. 30. A return to normal stage was greatly delayed in the marsh lands, where there were no ready means of escape for water brought in by the storm. Only an approximate estimate can be made of the net rise of level of Lake Pontchartrain, it being my opinion that this was not much less than 5 ft. and probably not as much as 6 ft. This net rise bears little relation to the effective rise along the borders of the lake. It is the latter with which engineers and others are particularly concerned.

There are several factors affecting the height to which storm tides may rise, the principal ones being velocity and direction of high winds, length of fetch of wind over the water, duration of high winds blowing from a critical direction and character of obstructions which might contribute to a piling up of the water.

Possible Future Tide Heights—Considering the Galveston storm of August, 1915, and the New Orleans storm of September, 1915, the velocities of the two storms and the time of their occurrence are given in the graph, Fig. 4, adapted from the records of the U. S. Weather Bureau. These storms are selected because both were storms of major intensity; they occurred during the same year, and the records were taken by staff observers.

Owing to the varying configuration of coast lines, a comparison of tides resulting from similar storms but in different localities is not particularly significant, but it is of interest to study the probability of effect of a given storm differently placed. For this purpose let us assume a storm having the characteristics of the Galveston storm of August, 1915, but following the path of the New Orleans storm of September.

Possible Formula—Referring to the graph, Fig. 4, it is noted that the Galveston storm maintained a velocity in excess of 30 m.p.h. for sixteen hours after the passing of the center of the storm (for convenience referred to as the zero hour), while the New Orleans velocities dropped below 30 m.p.h. within two hours after the zero hour.

While it is not proposed as a yardstick by which resulting tides may be computed, it is obvious that the figure of velocity multiplied by the time of high winds may be accepted as a factor in the computation of the tides, the difficulty being in the selection of a suitable exponent to this product to insure the proper result. Even with-

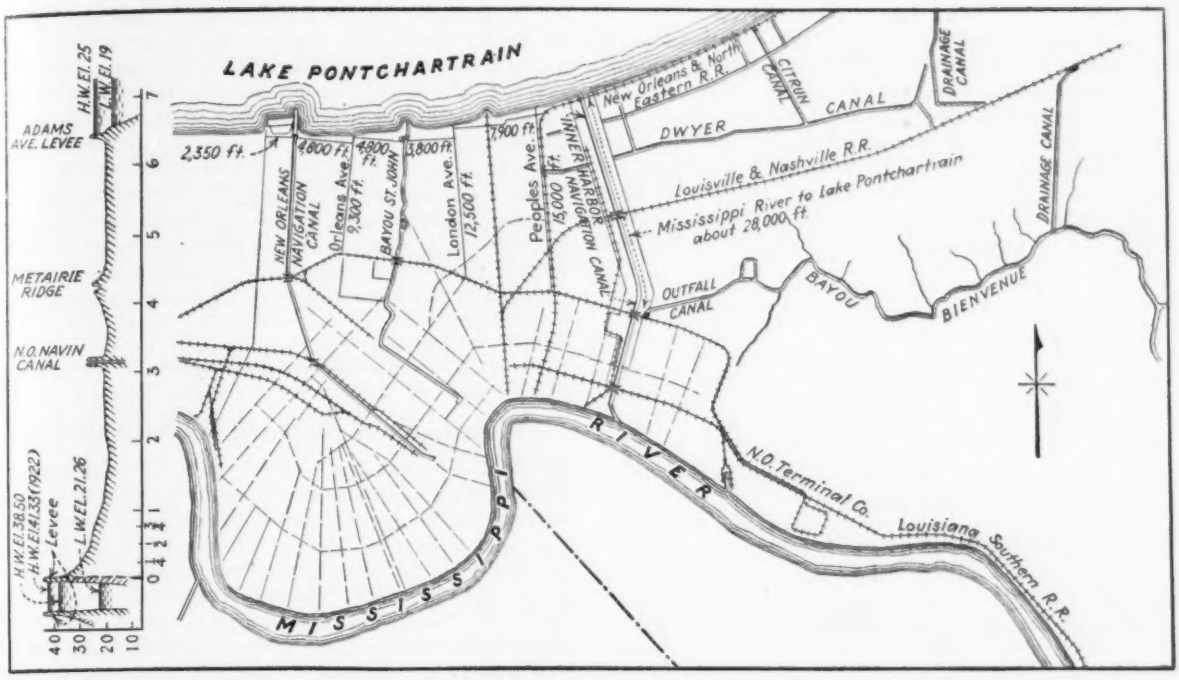


FIG. 2—DETAIL MAP OF NEW ORLEANS AND PROFILE, SHOWING CITY, LAKE AND RIVER LEVELS

out completing the formula, however, some idea of relation may be gained by comparing the products proposed. In the case of the Galveston storm the product for the first ten hours following the zero hour would be 605 miles, while for the New Orleans storm it would be 326 miles.

With a 13-ft. tide on the west shore of the lake resulting from the actual storm of 1915, it is reasonable to assume that, had the wind continued at a high velocity for ten hours after the zero hour and from a critical quarter, the height attained would have been greater. In this particular case, however, it is not probable that the increase in height would have been in accordance with any formula which might be devised, as the floodwater already had begun to escape over the railway embankment and through the timber swamp into Lake Maurepas and its surrounding swamp areas. Also, with a uniform velocity and direction of wind, we may assume that there is a limiting slope to the water surface beyond which the wind cannot hold the water; any rise beyond this critical limit could occur only as the result of a general rise of the entire lake surface.

Probable City-Front Hazard—Owing to its position with respect to the direction of movement of hurricanes which might affect the level of the lake, the city frontage cannot be subjected to extreme stages, though it appears probable that stages in excess of those previously recorded might occur as the result of a back surge from a maximum effect on the west and north shore, augmented by a wind shifting to the north. It is also conceivable that an even greater tide than that of 1915 might occur along the Bayou Bienvenue and the lower protection levee.

Until the tide reaches a height greater than that of the intersecting railway and highway embankments, the flow to Lake Pontchartrain is practically limited to the capacity of the two major connections with open water, the Rigolets and Chef Menteur, the former having an effective cross-section (at Gulf-level stage) of 72,000 sq.ft. and the latter of 23,000 sq.ft. During heavy storms it is not uncommon for a 6-ft. stage to be maintained for several hours in these two passes. At this stage the total effective area is increased to 118,000 sq.ft. At higher stages storm tides have passed over or breached the embankments, resulting in a considerable flow over the prairies. With the strengthening and raising of these obstructions to flow, however, and taking into consideration the retarding effect of growth on the open prairies, it probably is safe to assume that the established waterways will be the principal factors of actual velocities of current in the Rigolets and Chef Menteur during storm conditions. Evidence secured from bridgetenders and boatmen would indicate that velocities certainly in excess of 6 miles per hour (about 9 f.p.s.) occur. This would indicate a flow through the two channels of more than 1,000,000 sec.-ft.

Effect of Bonnet Carré Spillway—Some concern has been expressed over the effect of levels in Lake Pontchartrain as the result of the operation of the spillway to be constructed at Bonnet Carré, which will discharge into the lake at a point near Frenier. The plans now under consideration contemplate the discharge of not to exceed 275,000 sec.-ft. at maximum stage of the river. It is planned that the gates of the spillway normally will remain closed but that they will be raised at times when extreme high water is to be expected. It is quite generally agreed that the effect of this additional discharge into the lake will be to raise the general level, though there is not a very close agreement as to just how much this increase will be, the estimates as to the effect along the city front being from 1 to 2 ft. Even though the higher estimate should prove to be correct, no serious injury could follow beyond impaired drainage of bordering lowlands, unless the operation of the spillway should coincide with high stages occurring from other causes.

In the event (which is remote) of a coincidence of high river and heavy storm tide in Lake Pontchartrain, it would be thoroughly feasible to close the spillway gates for the few critical hours of the storm. Considering the possible control of the spillway and the apparently slim chance of coincidence of high river and storm

tides, it is probable that the provision of levees having an ample margin above the extreme storm tide level would afford ample protection to the city from lake overflow.

Raising the Levees—The city of New Orleans through the Orleans Levee Board has just adopted a plan for an increase in height and section of what is known as the upper protection levee. This levee not only is for the protection of the city from overflow originating in Lake Pontchartrain but is designed to prevent overflow from the river in the event of a break in the main river levee

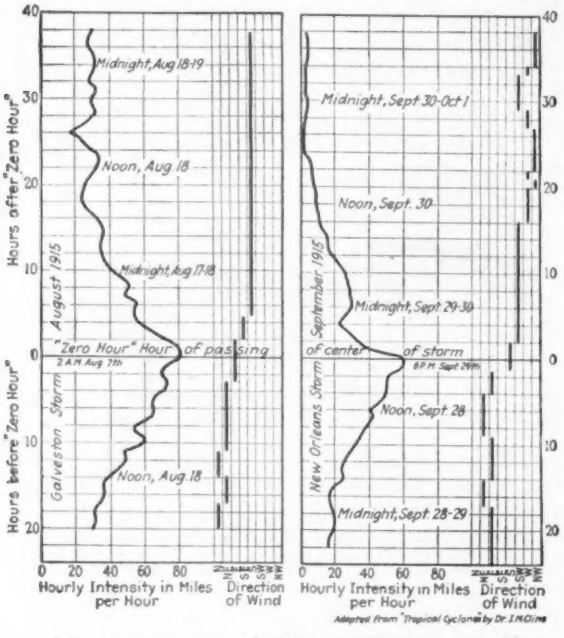


FIG. 4—WIND VELOCITIES IN STORMS OF 1915

at some point above the city. This levee is already above any possible lake flood height. The adopted grade of the lake front and low protection levees is about 10 ft. above mean lake level, though the embankments along the various canals leading back into the city fall considerably short of this elevation. There has not been in recent years a general flooding of the city from storm tides, through the levees on some of the canals mentioned have been overtopped at certain points, thus adding a considerable amount of floodwater to the rain water which must be pumped off. Considering the value of property affected and the possibility of even greater storm-tide heights, it appears that the city would be justified in adopting even a somewhat higher protection-levee grade, and certainly should bring all levees to the standard now adopted.

Abandoning Canals—There has been considerable agitation recently looking toward the abandonment either in whole or in part of the two small navigation canals which lead into the central part of the city or (if they are not to be abandoned) to protect the lake connections by the construction of flood gates. This would avoid the necessity of increasing the height of embankments flanking these waterways. The pumping plants which discharge into the drainage outlet canals are set well back on the lake shore. The setback of the plants pumping to Lake Pontchartrain will average about 2½ miles. There does not appear to be any reasonably feasible means for protection from overflow from these outfall canals other than to increase their bank heights to a level above that of maximum tides.

The facts as presented indicate a decided need of attention by New Orleans to its water hazards. They are not difficult or ordinarily costly to overcome. The chief obstacle is not lack of engineering knowledge of the situation or of engineering means to perform the task; it is the positive lack of consciousness by the public that anything needs to be done. New Orleans has had a fortunate record of freedom from the storm-tide damages from which other Gulf coast communities have suffered, but there is no assurance that this experience will continue except through adequate levee protection along its lake and lowland fronts as well as along the Mississippi River front.

Advantages of Built-Up Wooden Beams

BUILT-UP wooden beams, made by fastening together two or more planks of like width with nails, bolts or similar devices, have unquestionable advantages compared with solid beams. They may be constructed of smaller lumber which is readily available and easily and quickly seasoned, and they contain fewer defects. This is the conclusion reached as a result of general observations of built-up members and of tests at the Forest Products Laboratory of built-up beams composed of planks free from defects. It is understood, of course, that built-up beams will be placed so that the load will fall on the narrow faces of the planks.

The opinion has often been expressed that where two or more boards or planks are used together and loaded so as to deflect or bend equally the stiffer pieces will take the greater share of the load and will therefore fail before the less stiff pieces. It is true that the stiffer pieces will take the greater load. Tests show, however, that a plank of high stiffness will normally bend slightly farther before it fails and will withstand a larger maximum load than a plank of low stiffness. In other words, beams built up of planks without defects, such as knots, will tend to fail in the less stiff rather than in the strongest planks and beams built up with planks containing defects will break first in the plank having the more serious defect, regardless of the load which is being sustained by any one plank.

The tests also show that staggering the defects does not add materially to the strength of the beam.

It is apparent that there is no marked difference in strength between built-up and solid beams; but because of other advantages they offer, built-up beams may well be used as girders in residence buildings, garages, barns and other structures. One of the principal advantages attaching to their use is that the material may be readily obtained in a dry or comparatively dry condition. This is in contrast to the condition of solid beams, which in the larger sizes may have a relatively high moisture content even after two years of drying.

Ordinarily solid beams can be obtained only on special order since only a few yards stock them in a variety of sizes. When ordered from the mill they are frequently received in a green condition. Their use in this condition lays them open to the difficulties incident to shrinkage and decay. Stock for built-up beams, on the other hand, may almost invariably be obtained from lumber yards on short notice. Moreover, they are relatively easy to put in place, do not have to be lifted by special means and can be constructed in any size and installed just as they are needed.

Unusual Foundation Design for Tall Steel Building

Short Concrete Piers Built in Open Wells Before Excavating Site to Full Depth—Side Shoring Avoided

By W. S. Wolfe
Chief Structural Engineer,
Smith, Hinchman & Grylls, Detroit, Mich.

UNUSUAL and interesting features of foundation design and construction, to meet special conditions, are included in the recently completed foundations of the fifteen-story steel-frame building for the Detroit chapter of the National Town and Country Club, at Detroit, Mich. This building will be approximately 100x160 ft., with a height of about 200 ft. above the street. There will be a basement over the entire site and a sub-basement covering about half the area of the site.

General excavation was made only to the basement level. The foundations consist of cylindrical piers 4 to 5½ ft. in diameter and 8 to 18 ft. deep, belled out at the bottom to give a load of about 3½ tons per square foot on the clay formation. They are, in fact, circular spread

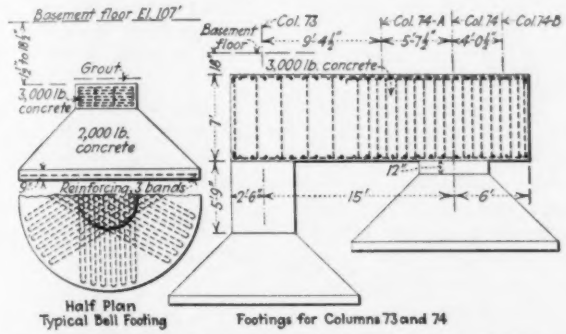


FIG. 1—TYPICAL FOOTING AND CANTILEVER GIRDER

footings put down by the open-well method, thus reducing the amount of excavation. Fig. 3 shows the site with all foundations finished in advance of full excavation. Fig. 2 shows the typical construction.

In order to save time it was decided to let the foundations as a separate contract, followed by the structural steel as another separate contract, both of these to be let before the drawings were ready for a general contract. It seemed desirable, therefore, to put in the foundations and proceed with the erection of structural steel with the least possible amount of shoring in excavation and without putting in any basement walls. In the view, Fig. 3, with footings completed and ready for the structural steel, the absence of shoring around the sides will

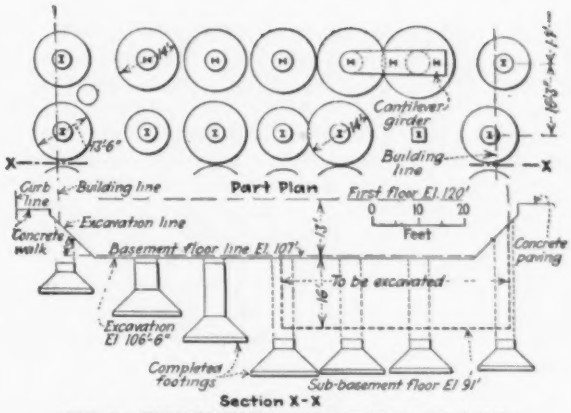


FIG. 2—FOUNDATIONS FOR CLUB BUILDING AT DETROIT

be noted, as well as the clean and unobstructed surface of the site, which is excavated only to the basement level, although all the foundations are built in the area for the sub-basement. It will be seen that a sloping bank is left along each side, between footings, in order to avoid shoring the banks.

The design and method used had many advantages and proved very successful in the field. In the first place, the price was low. There was no backfilling, as would have been the case if the ordinary spread footings had been used. For such footings it would have been necessary in each case to cut a shaft as large as the footing from the bottom of the general excavation to the bottom of the footing. The dimensions of the general excavation would have been larger, and there would have been troublesome banks to hold for a long time.

With the design described, the bottom of the excavation is left clean and unobstructed, with only small holes extending down to the footings. Since the footings were poured against undisturbed soil, the difference in elevation between adjoining footings could be much greater than if ordinary footings had been built in the usual way. The excavation will be completed and the basement walls poured between and around the columns after the lower part of the steel frame has been erected and work is progressing on the superstructure.

The soil is blue clay, which held its shape in the belled footings without the use of forms. Excavation was

FIG. 3—FOOTINGS COMPLETED BEFORE FULL EXCAVATION
Tops of piers and cantilever girder flush with surface at left. Planks cover wells in ground to be excavated. Note absence of shoring of banks.

handled with pneumatic tools, in lifts of about 5 ft., each lift being lined with wood staves supported by ring braces. Steel reinforcement for each footing (Fig. 1) consists of three bands in the base of the bell and a spiral hoop with vertical spacing bars in the top of the pier, on which the column base will rest. A reinforced-concrete cantilever girder, also shown in Fig. 1, is required at one point to fit an unsymmetrical arrangement of columns necessitated by location of the entrance to one of the large rooms.

The foundations were put in by the Spencer, White & Prentis Company, Detroit, Mich. Smith, Hinchman & Grylls, of Detroit, are the architects and engineers.

Improved Field Equipment for the Determination of pH

Complete Range of Standards and Indicators Carried in Small Case—Small Quantities to Eliminate Turbidity Effect

By E. Hurwitz and L. S. Kraus

Principal Assistant Chemist and Assistant Chemist, Sanitary District of Chicago

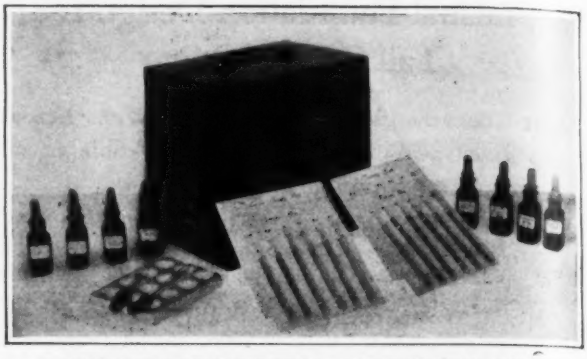
During the past few years studies have been made in the main laboratory of the Sanitary District of Chicago of various types of apparatus for determination of hydrogen-ion concentration by the colorimetric method. We desired to assemble apparatus for field work that would be compact and accurate and cover a wide range of pH values.

We had at our disposal three types of colorimetric kits: (1) A kit of prepared color standards, 10 c.c. in volume, which requires a like amount of the unknown for the determination; (2) a kit of the "vest pocket" type with prepared color standards sealed in capillary tubes, which require a very small portion of the unknown for the determination; (3) a kit of the "dropping plate" type, in which the color standards are prepared (at the same time of making the determination) on a color-reaction plate from buffers included in the kit. This kit also requires only a small sample.

It was apparent immediately that an apparatus of the first type was not satisfactory. Although it was all that could be desired from the point of accuracy, the large number of 10-c.c. tubes necessary to give a complete range of pH values and the requirement of a 10-c.c. sample made this apparatus cumbersome and not fit for field work.

Sets of type 2, although very compact, are not accurate for determination of the pH of solutions unless the solutions are highly buffered. The amount of the indicator necessary to produce a perceptible color in a fine capillary tube is large in proportion to the unknown used. Consequently if the unknown is of low buffer content, its pH value will be changed by the indicator, which is alkaline as prepared. Sets of type 3 approach most closely to meeting the requirements. They are compact, portable and accurate, but a large number of buffer solutions must be carried to give a complete range.

For the purpose of combining the desirable features of the three types of pH comparators described above and to eliminate their undesirable features our laboratory developed a new set. Our set consists of color standards made with Clark buffers and indicators, using 1 c.c. of 0.04 per cent indicator per cubic centimeter of buffer except for the brom-thymol-blue range. In this range the indicator is made up double strength, and 1 c.c. of this 0.08 per cent solution is used. The standards are sealed in Pyrex glass tubes 10.5 to 11 cm. long with a bore of approximately 4 mm. and a capacity of about 1 c.c. These are mounted on chalk-white celluloid cards, 5⅛ in. wide by 5½ in. long. The cards are labeled with the name of the indicator used and each tube with its pH value. The indicators are contained in a 15-c.c. dropping bottle which holds enough solution for at least 300 determinations.



COMPACT FIELD KIT FOR pH DETERMINATION
In front are indicator bottles, then reaction plate, and in back are pipettes and color standards.

The pipettes used for color comparison are made of the same tubing as the color standards. The dropping plate on which the unknown is mixed is an ordinary twelve-depression color-comparison plate. The whole apparatus, including color standards, indicators, color-reaction plate and pipettes is fitted into a compact kit from which it can be easily and conveniently removed for use (see illustration).

The determination of pH value is carried out by pipetting into a depression of the color reaction plate approximately 1 c.c. of the unknown solution, using the pipettes furnished with the kit. Then one drop of indicator is added to the unknown and the whole is thoroughly mixed by drawing into and expelling from the pipette. The liquid is then drawn back into the pipette and the reading is made by comparison with the color standards described above.

Continued use tends to soil the celluloid cards on which color tubes are mounted, but these can be washed with soap and water, using a small brush such as a pipette brush or a pipe cleaner to get under the tubes.

This comparator seemed to meet all requirements in that: (1) It is extremely compact. A complete range of color standards from 1.8 to 9.2, a complete set of indicators and all equipment necessary for the determination of pH value can be carried in a kit only 9 in. long by 6 in. wide by 8½ in. high. (2) It permits the use of a very small quantity of sample, thus eliminating to a great extent the effect of turbidity and making possible its use with slightly colored liquids. (3) The proportion of indicator to liquid to be tested is small enough so that there is no influence of the indicator on the pH of the unknown. Thus the pH of solutions of very low buffer content can be accurately determined. (4) The indicators are adjusted to the middle of their range.

Fourth of a Series of Five Articles

Basic Principles of Concrete-Making

By F. R. McMillan
Director of Research, Portland Cement Association, Chicago

IV—Application to Specific Conditions

Curing Period Required—Water-Cement Ratio to Use—Selection of Aggregates—Trial Mixtures—Examples of Unsound Aggregates

IN THE preceding discussions the basic principles of concrete mixtures were established. In those to follow it will be the purpose to present some of the considerations which are necessary for applying these principles to a particular structure. In this article attention will be given to the selection of the aggregates and to the establishment of maximum water-cement ratios and minimum curing requirements. In the fifth article attention will be given to such matters as measurement of materials, mixing, transporting and placing the concrete.

Minimum Curing Period

It was brought out in the discussion of Figs. 8 and 9 in the second article that water-cement ratio and degree of chemical combination are interrelated in the development of strength in the cement paste. Changing either factor—the water-cement ratio or the degree of curing—does not alter the importance of the other factor. Thus, within certain limits, a particular strength or watertightness can be developed by several different water ratios, provided the concrete in each case receives the appropriate degree of curing.

This relation between curing, water-cement ratio and strength is nicely brought out by the curves in Fig. 23, which show the effect of both the water-cement ratio and the temperature on the compressive strength of moist-cured concrete at different ages. The curve for the 28-day strength at 70 deg. F., is that first given by Abrams and corroborated by many subsequent tests. The curves for 70 deg. F. at the ages of 1, 3 and 7 days are based on tests in the Research Laboratory of the Portland Cement Association, using the regular laboratory mixture of equal parts of four standard portland cements. The curves for the other temperatures for all ages were deduced from the curves for 70 deg. F. on the basis of data given in Bulletin 81 of the Engineering Experiment Station of the University of Illinois, "Influence of Temperature on the Strength of Concrete," by A. B. McDaniel.

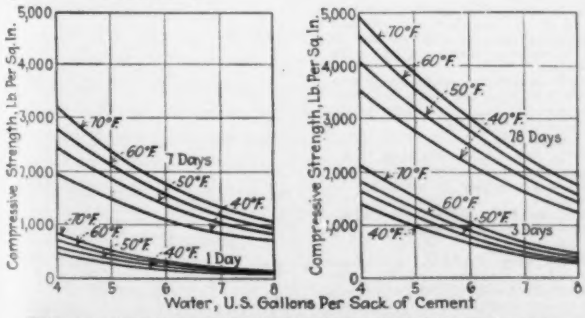


FIG. 23—WATER-CEMENT RATIO STRENGTH RELATION FOR MOIST CURING AT DIFFERENT TEMPERATURES

An illustration from the curves of Fig. 23 will show the necessity of fixing some degree of curing before selecting a water ratio for definite strength requirement. From these curves, for example, it can be seen that a strength of 2,000 lb. per sq.in. can be obtained by any of the following combinations:

Water-Cement Ratio, Gal. Per Sack	Temperature, Deg. F.	Age, Days
4	70	3
5	60	7
5½	70	7
6	40	28
7½	70	28

The other data which have been presented indicate an equally important effect of the curing on the water ratio required for a particular degree of exposure.

The usual practice in regard to the strength of concrete has been to specify mixtures or water-cement ratios on the basis of the strength shown for 28 days' moist curing at 70 deg. F. This has been accompanied by some more or less nominal requirement in the specification as to protection to be given on the work, the assumption being that, with some protection during the first few days, the concrete in the structure will eventually exceed the strength corresponding to the 28 days' moist curing. Experience has shown that this is generally true, due to two primary factors. First, completely adverse weather conditions are quite rare, and even though the protection is removed some normal increase is to be expected which does not cease at the 28-day period. Second, the practice of testing the moist-cured laboratory specimens in a saturated condition, upon which the greater part of our knowledge is based, gives a strength value only about 80 per cent of that shown when the specimen is reduced to an air-dry condition comparable with that in the concrete of the structure when put into service.

In large mass construction the conditions may be quite favorable, due to the slow evaporation from a large volume of concrete. This slower evaporation is especially favorable in localities where rainy spells occur only a few weeks apart. Large volume is also an advantage in cold weather, as the heat generated by the reactions of setting and hardening is considerable in large masses. These are fortunate circumstances, because structures of this type are usually those which have to resist the weathering effects of the elements. In the case of buildings or other structures of thin sections, the conditions are quite the reverse. In summer, the free circulation of air on all sides of the thin members causes rapid evaporation, whereas in the winter there is no mass effect to conserve either the heat generated by the chemical reactions or that applied to the materials for protection during the early period. If the concrete in build-

ings were generally required to be watertight, the usual curing methods employed would probably be found inadequate, in spite of the fact that in most cases the mixes are potentially capable of producing watertight concrete. In road slabs the conditions for curing are extremely unfavorable owing to the large unprotected area exposed to the direct action of sun and wind. This, combined with the severe service which the roadway must meet, has made curing one of the principal problems of road construction. Highway engineers have long recognized this difficulty and have done much in the development of curing methods.

Obviously, exactly the same conditions cannot be expected in all cases, but in view of the importance of curing, particularly in the early period, it would seem both sound and reasonable practice to require a certain minimum period of controlled conditions. Any unfavorable conditions following this cannot reduce the quality of concrete below that intended, and any specially favorable condition can merely add to the factor of safety.

In Table VII, where recommended water-cement ratios are given to meet different conditions of exposure, a minimum curing condition has been assumed that will be the equivalent of that obtained when the concrete is protected from the loss of moisture for at least 10 days at a temperature of 70 deg. F. Where the conditions following this period are to be unfavorable (thin sections in hot, dry air or in low temperatures), the only way to meet this requirement is definitely to require the full 10 days of moist curing at 70 deg. F. Where the subsequent conditions are to be favorable to continued hardening (mass concrete in moist air at moderate temperatures), this period can be somewhat shortened. However, no concrete structure should be exposed to drying conditions before 5 days of moist curing at 60 deg. F. or more unless the water-cement ratios have been selected with this in view.

The above-mentioned minimum requirements contemplate some continued chemical action for considerable periods beyond the 10 days. Without this favorable beginning, however, such continued activity cannot be assured. These limits are recommended as suitable for most specifications, with the suggestion that for special conditions additional curing may be the most desirable way to obtain the required results.

Selection of the Water-Cement Ratio for Strength

From the foregoing discussion it can be seen that the water-cement ratio to use for definite strength requirements cannot be selected without first taking into consideration the curing conditions that are to prevail. Following the line of reasoning in that discussion, it is recommended that, for the ordinary structural requirements, the usual practice be followed of selecting the water-cement ratio on the basis of strength tests at 28 days in which the specimens are moist cured at 70 deg. F. and tested wet. When this is done, the curing of the structure should be the equivalent of that recommended above as the minimum curing period.

Whenever possible, strength tests should be made for each particular project using the identical materials—cement, aggregates and water—intended for the structure. This may be of considerable importance where unusual materials are encountered. When this is done, the procedure should be that outlined below. In the absence of such tests, the curve in Fig. 23 for the 70 deg. curing can be taken as satisfactory for *average materials where good workmanship and careful measurement of the water will be assured.* This curve is that first given by Abrams and has been found to be a satisfactory basis for design under these conditions.

As pointed out in the second article in this series, the greatest difference between various cements lies in the strength at the early ages. For that reason the curves in Fig. 23 for the 1-, 3- and 7-day periods cannot be used with so great reliability as those for the 28-day periods. Where the strength at early ages is to be a governing feature of the work, the use of special tests to obtain a "job curve" as mentioned above will be particularly advantageous. These curves in Fig. 23 for the early ages, however, can be taken as indicative of the average results which may be expected from a wide variety of cements. The curves may be very useful, also, in showing the relation between the strength and the temperature of curing.

Where tests are to be made to determine the water-cement ratio strength relation for the particular materials to be used, they should generally be on the basis of moist curing at 70 deg. F.; the specimens being placed in the moist room (or under water or wet sand at 70 deg. F.) 24 hours after casting and kept there until tested. By following this procedure the results will be directly comparable with any subsequent tests which may be made on the work and with the vast literature of concrete, which is principally recorded in terms of the 28-day tests on this basis.

Job Curve Desirable

As a check on the effectiveness of the protection being afforded the structure, tests should be made from time to time on specimens to which protection has been given comparable with that given the structure itself. Iden-

TABLE VII—RECOMMENDED WATER-CEMENT RATIOS FOR CONCRETE TO MEET DIFFERENT DEGREES OF EXPOSURE

These requirements are predicated on the use of concrete mixtures in which the cement meets the present standard specifications of the American Society for Testing Materials and to which an early curing is given that will be equivalent to that obtained when protected from the loss of moisture for at least 10 days at a temperature of 70 deg. F. Also that the concrete is of such consistency and is so placed that the space between the aggregate particles is completely filled with cement paste of the given water ratio.

Exposure \ Class of Structure	Reinforced Piles, Thin Walls, Light Structural Members	Reinforced Reservoirs, Water Tanks, Pressure Pipes, Sewers, Canal Linings, Dams of Thin Sections	Heavy Walls, Piers, Foundations, Dams of Heavy Sections
	Water-Cement Ratio, U. S. Gal. Per Sack*		
Extreme:			
1. In severe climates like in northern U. S., exposure to alternate wetting and drying, freezing and thawing, as at the water line in hydraulic structures	5½	5½	6
2. Exposure to sea and strong sulphate waters in both severe and moderate climates			
Severe:			
3. In severe climates like in northern U. S., exposure to rain and snow, and freezing and thawing, but not continuously in contact with water	6	6	6¼
4. In moderate climates like southern U. S., exposure to alternate wetting and drying, as at water line in hydraulic structures			
Moderate:			
5. In climates like southern U. S., exposure to ordinary weather, but not continuously in contact with water	6¾	6	7½
6. Concrete completely submerged, but protected from freezing			
Protected:			
7. Ordinary inclosed structural members; concrete below the ground not subject to action of corrosive groundwaters or freezing and thawing	7½	6	8¼

* Free water or moisture carried by the aggregate must be included as part of the mixing water.

tical protection for the specimens and the structure is difficult to obtain owing to the greater loss of water and change of temperature in the small isolated specimen, as compared with the larger structural members. However, if care is taken to get proper protection, the test results will give a reliable indication of the quality of the concrete in the structure. Such tests can be very useful in fixing the periods when forms may be removed or the structures opened to service. If the curing conditions have been unfavorable, these "follow-up tests" will give a basis of fixing such additional curing as may be necessary.

In special cases it may be desirable to base the job curve for the design of the mixes on tests of specimens cured under conditions as nearly identical as possible with those to be encountered on the work. This is more apt to be the case where a definite strength at some early period is attempted, either through the use of rich mixtures of normal concrete or by special rapid-hardening cements. Under such conditions the field-cured specimens may be preferable. Ordinarily, however, the standard curing is to be preferred, as it gives the potential quality of the concrete. Where only the field-cured specimens are used, deficiencies in strength due to mixtures or materials might be ascribed to improper curing or vice versa.

In making tests for the establishment of a job curve showing the water-cement ratio strength relation, there should be included a sufficient number of water ratios to give several points on the curve with a number of specimens for each water ratio. Standard procedure should be followed in making the tests and the mixes and consistencies used should be approximately those which are likely to be used on the work.

Recommended Water-Cement Ratio

Durability as a Factor—The major influence of the water-cement ratio on the watertightness of the concrete and therefore on its durability has been brought out. Unfortunately, the data available do not lend themselves to the establishment of a direct relation between the water-cement ratio and some required degree of durability as is possible in the case of strength. Any decision therefore as to the water-cement ratio to use must be based on a study of the performance of structures in service in connection with the available data on freezing and thawing, and permeability. Almost every effort to analyze the performance of structures meets with some difficulty because of the meager character of the records relating to the mixes, water-cement ratios, materials and other factors at the time of construction which have contributed to the present condition of the structures.

Recognizing these difficulties, the author has nevertheless attempted from such information as is available to set up a guide for the selection of the water-cement ratio to use for different classes of structures and degrees of exposure. These recommendations are given in Table VII. They are intended to apply only when plastic and homogeneous mixtures are used and when the cement meets the present standard specifications of the American Society for Testing Materials. They further assume a minimum curing, equivalent to that obtained when protected from the loss of moisture for at least 10 days at a temperature of 70 deg. F.

In presenting these recommendations, the limitations of the basic data are fully recognized. It is appreciated that examples can be cited where satisfactory results have been obtained with water ratios greater than those indicated; also, that unsatisfactory experience has resulted from the use of perhaps even lower proportions of water. It is believed, however, that for the conditions indicated, the recommended water-cement ratios are safe and yet not unduly conservative. As pointed out elsewhere, where the curing conditions are less favorable than indicated in the table or where the curing period must be shortened, the water-cement ratios should be reduced.

Correction of Water-Cement Ratio for Free Water and Absorption

It has been pointed out in the earlier articles that the quantity of water in the paste which is effective in determining its properties is that actually in the paste as the concrete lies in place at final consolidation. Any water that is lost from the mixture during transportation and placing is properly deductible from the quantity of water added at the mixer in computing the true water-cement ratio. Such loss of water may be through evaporation or through absorption by the aggregate. In hot, dry weather with dry aggregates these losses may be very considerable and justify making additions of water at the mixer to allow for them.

In the same way free water or moisture in the aggregates must be taken into account in computing the water-cement ratio. Most sands and gravels are now the product of wet screening plants and come to the job with varying amounts of free moisture. For proper control of the concrete it is necessary that the amount of this free water be known so that the water added through the measuring device can be adjusted to give the required water-cement ratio. There are a number of methods of measuring the water carried by aggregates which can be used successfully on the job without expensive or elaborate equipment. These have been described in technical papers and committee reports in recent years. The reader is referred to the *Proceedings* of the American Concrete Institute and of the American Society for Testing Materials for these descriptions.

The method of drying over an open fire or oil stove is still quite widely used and is perfectly satisfactory. A variation of this method consists in spraying the aggregate sample with alcohol and igniting. Two or three applications of small quantities of alcohol will serve to dry thoroughly a very wet sample. When drying the sample to establish the quantity of free moisture in the aggregate, it is necessary to know what portion of the water driven off is free water which would become part of the mixing water in the concrete, and what portion is in the aggregate in the form of absorbed water which would remain in that form and have no effect on the water-cement ratio. This is best determined by driving off all the water and subtracting the amount which the aggregate can absorb, which is determined by a separate test for absorption.

Selection of Aggregates—Grading

In the third article of this series a method was given for selecting aggregate combinations to meet the requirements of placing. By this method several combinations of the available materials are compared in trial mixes using a cement paste of the required water ratio. The combination most suitable for the particular structure is judged by the relative workability of the mixes and their cost. The cost is determined by measuring the materials used and the yield of concrete for the several batches. The trials can be in small

FIG. 24—PORTION OF A QUARRY FACE AFTER SIXTEEN YEARS' EXPOSURE. SHOWING DISINTEGRATED STRATA OF LIMESTONE

batches mixed by hand or full-sized batches in the mixer. Corrections, of course, are to be made in the water ratio for free moisture carried by the aggregates.

By this same method, aggregates from several sources or of different gradings from the same source can be compared, the decision being based on the relative workability of the various batches and their total cost. In comparing the cost of mixtures differing in workability, consideration must be given to the relative cost of placing, for small advantages in cost of materials might easily be wiped out by an increase in the cost of handling and placing a less workable mix. In estimating such differences in cost of placing, allowance should also be made for possible delays which may result from the effort to use harsh-working mixtures.

This trial method of arriving at suitable proportions of aggregates is not nearly so formidable as many have assumed. Where only one fine and one coarse aggregate are under consideration, anyone familiar with concrete practice should arrive at approximately the right proportions in two or three trials. Even one not thoroughly familiar with the handling of concrete should not require very many trials if he keeps in mind the two essential requirements—the specified water ratio and a plastic mixture that can be properly placed. Let the first batch be anything that comes to mind. If this is very far from a reasonable mixture, it will be at once apparent even to a novice, and some modification such as adding more paste or more aggregate can be made before the mixing is complete. Subsequent batches can be based on this first one, first increasing the proportion of fine and reducing the coarse, through a few stages, then varying in the opposite direction. It must not be forgotten that the studies in the other articles of this series have shown that a considerable range in aggregate proportions does not materially affect either the quality or the cost of the concrete when a fixed water-cement ratio is maintained.

With a good working batch once arrived at, further modification can be made as the work progresses, using the full-sized batches from the mixer as a basis of comparison. The different batches can be judged solely on the basis of how they place, or (by calibrating the skip or hopper) difference in yield can also be taken into account. Such a study of the concrete being placed is to be recommended even when the mix to use has been worked out rather carefully in advance, for it is finally the behavior on the work that measures the suitability of the mixture.

Another method of arriving at the desired proportions from trial batches is to begin with the combination of the fine and coarse aggregate which gives maximum weight of mixed aggregate. The proportions required to give maximum weight can be determined by trial. For aggregates of approximately the same specific gravity, that combination which gives maximum unit weight dry will also give approximately the greatest yield of concrete for a given quantity of cement and its fixed proportion of water. By making the first trial batch from this combination of aggregates, a few trials, first in one direction and then in the other, should quickly result in the most desirable combination considering workability, cost, etc. The discussion of the limitations on the proportion of fine aggregate in the third article should be reviewed in this connection.

Where fine and coarse aggregates are available from several sources, the number of trial batches can be reduced by a preliminary study of the aggregates alone to find the proportions which give the greatest unit weight of mixed concrete for each fine aggregate combined with each coarse. Trial batches of concrete can then be limited to the combinations of mixed aggregates of maximum weight. These trials should give information through which all but one or two combinations can be eliminated from further consideration. The most favorable combinations can then be studied in more detail, using proportions of fine to coarse varying in both directions from those giving maximum weight. From these more detailed studies the most economical mixtures giving the necessary workability with the given water-cement ratios can be determined in the same manner as when only one sample of fine and one sample of coarse are available.

Selection of Aggregates—Strength and Durability

In the foregoing discussion it has been assumed that the aggregates are suitable as to mineral composition and physical characteristics. Fortunately, most of the common aggregate materials are suitable in these respects, but occasions frequently arise when some determination must be made as to these properties.

Impurities—In the matter of cleanness and freedom from impurities, it is difficult to set up rigid limits which separate desirable from undesirable aggregates. The following limitations have been abstracted from the tentative specifications adopted by the American Concrete Institute

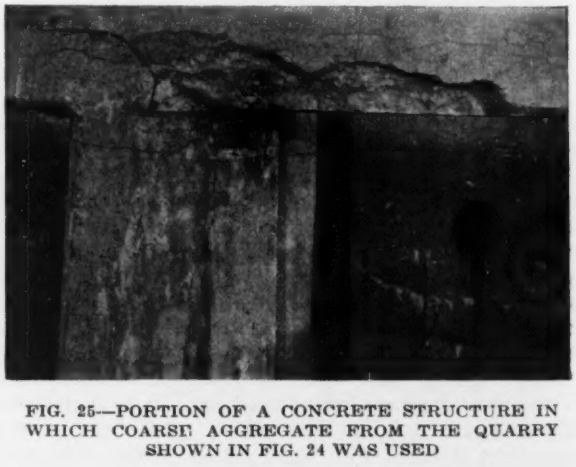


FIG. 25—PORTION OF A CONCRETE STRUCTURE IN WHICH COARSE AGGREGATE FROM THE QUARRY SHOWN IN FIG. 24 WAS USED

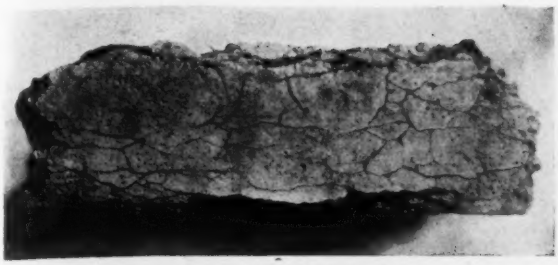


FIG. 26—SPECIMEN OF CONCRETE IN WHICH UNSOUND COARSE AGGREGATE HAS CONTRIBUTED TO THE DISINTEGRATION

in February, 1929. These may be taken as satisfactory for the ordinary deletericus substances. The exact percentage which might in certain cases be permitted could vary somewhat from those given. The 1 per cent limit on shale seems unduly restrictive. For ordinary conditions, from 3 to 5 per cent, would not be objectionable. Except for the undue restriction on shale content, the maximum of 5 per cent of the total impurities, which is intended to apply to the fine and coarse aggregates separately, seems to be a reasonable requirement.

Deleterious Substances.

2. (*a*) The maximum percentages of deleterious substances shall not exceed the following values:

	Per Cent by Weight	
	Fine Aggregate	Coarse Aggregate
Removed by decantation	3	1
Shale	1	1
Coal	1	1
Clay lumps	1	½
Soft fragments	..	5
Other local deleterious substances (such as alkali, mica, coated grains, soft and flaky particles, friable, thin, elongated or laminated pieces)	..	..

Note: It is recognized that under certain conditions maximum percentages of deleterious substances less than those shown in the table should be specified.

(*b*) The sum of the percentages of shale, coal, clay lumps, soft fragments and other deleterious substances shall not exceed 5 per cent by weight for either the fine or coarse aggregate.

(*c*) All fine aggregate shall be free from injurious amounts of organic impurities. Aggregates subjected to the colorimetric test for organic impurities and producing a color darker than the standard shall be rejected unless they pass the mortar strength test as specified in section 4.

The requirement for a colorimetric test is now quite general and seems to be warranted by experience in the field under average conditions. There are localities, however, in which aggregates carry certain impurities that give a dark color in the test but which do not reduce the strength of concrete in which they are used. Lignite is an example of such an impurity; nevertheless it should not be permitted in considerable quantities where surface appearance is important. Aggregates which make an unsatisfactory showing in the colorimetric test should not be used unless their suitability is established by strength tests.

Strength of Aggregate—The suitability of the aggregate as regards strength can, of course, be determined by tests in concrete mixtures in comparison with the aggregates of known quality, using the water-cement ratios specified for the particular structure. In such tests it may be desirable to include also water-cement ratios somewhat lower than are intended in the structure. The increased strength from these richer mixes will be influenced in some degree by the protection offered by the paste, but they should disclose any serious weakness of the aggregate that might not become evident in short-time tests with the water-cement ratios specified.

Soundness of Aggregate—The durability of an aggregate cannot be determined so easily as its strength. In most localities there are sources of aggregates which have been long in use and which have given satisfactory service. When aggregates are available from such sources, no special study or tests need be made. When, however, new sources of supply are to be opened, it is desirable that some examinations and tests be made before accepting the material for use. This is particularly important in structures that are intended for extreme or severe exposure, for even though a good quality of paste may offer considerable protection to the aggregate particles, any weakness of the aggregates themselves may eventually develop in such exposure.

Where the aggregate is to be crushed from the ledge rock, a thorough examination of the ledge itself gives the best indication of the ability of the rock to withstand weathering. Such an examination, of course, should cover all the strata which are to be included in the quarrying operations at points where they have been exposed for long periods of time. Failure to observe these precautions may result in diasappointment, for many rocks which appear sound and durable in a freshly opened quarry face will disintegrate upon exposure to the destructive forces of weathering.

A test that is now quite commonly applied to determine the soundness of aggregates consists in the immersion of the rock in a sodium sulphate solution alternated with periods of drying in an oven. The samples are kept immersed for twenty hours in a saturated solution at 70 deg. F., after which they are dried for four hours at 212 deg. Samples which exhibit marked disintegration after five repetitions of this treatment are considered to be unsound. While this test has not been thoroughly co-ordinated with the performance of aggregates in structures, it is quite generally considered as providing a useful measure of durability.

Examples of Unsound Aggregates in Concrete—Fig. 24 shows a picture of a limestone deposit in which some of the strata are definitely unsound. Fig. 25 shows a portion of a concrete structure which was built using aggregates from this deposit. The portion shown in Fig. 24 was the working face of the quarry during the period when the structure was being built. The disintegration of some of the strata, which is clearly shown in the illustration, has all taken place during the sixteen years that this quarry has remained idle. The appearance of the concrete in Fig. 25 is characteristic of that resulting from the use of unsound aggregates.

Another example of concrete in which unsound aggregate has largely contributed to the disintegration is shown in Fig. 26. The coarse aggregate used in this structure is a weathered limestone slightly seamed with calcite which failed to pass the sodium sulphate test. The characteristic effect of unsoundness, shown in this illustration, will develop rapidly or slowly, depending on the properties of the cement paste. Where the exposure is not too severe and the cement paste is very impervious, the unsoundness may never be disclosed. However, with an aggregate of doubtful quality, too much reliance should not be placed on the protection offered by the paste unless the record of performance includes its use where the exposure has been sufficient to provide a thorough test of its weathering qualities.

In the fifth and concluding article attention will be directed to the importance of proper construction methods.

Mr. McMillan's fifth article will appear May 9.

ROADWAY 23-FT. WIDE FOR TWO-WAY TRAFFIC
Signal lights on center line of ceiling direct motorists.

Methods of Controlling Traffic in the Oakland Estuary Tube

Control Centered at One Portal—Three Light Signals Placed in Ceiling 200 Ft. Apart—Operation Thus Far

TRAFFIC control methods under which 2,330 vehicles per hour have been effectively handled in the vehicular tube under the estuary between Oakland and Alameda, Calif., recently named the George A. Posey tube, were put into operation late last year and are reported to be entirely adequate. A description of the ventilating system for this precast subway appeared in *Engineering News-Record,* March 10, 1927, p. 392, and previous articles described the design and construction. Traffic control equipment and methods are described in the following.

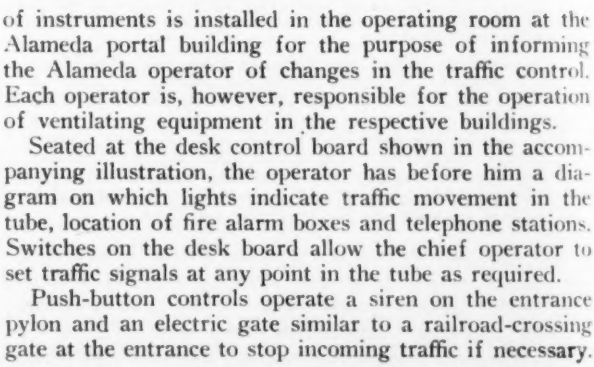
The principal dimensions of the tube are: total length, 4,436 ft.; length between portals, 3,545 ft.; headroom, 14 ft. 10 in.; width of roadway between curbs, 22 ft. 10 in., which provides for one traffic lane each way. There is a 3 ft. 5 in. elevated sidewalk on either side of the roadway. Grades at the ends are 4.50 and 4.59 per cent respectively.

Traffic moves through this tunnel governed by regulations of which the following are the essentials: (1) Speed shall not exceed 25 miles per hour, with an interval of 50 ft. between vehicles unless directed otherwise by an officer; (2) horsedrawn vehicles are prohibited; (3) vehicles which cannot maintain a speed of 5 m.p.h. on the upgrade of 4.5 per cent are prohibited; (4) drivers shall not leave the lane of traffic in which they are traveling or pass vehicles going in the same direction; (5) no driver shall obstruct a traffic lane by slow driving or by stopping for repairs or to change a tire.

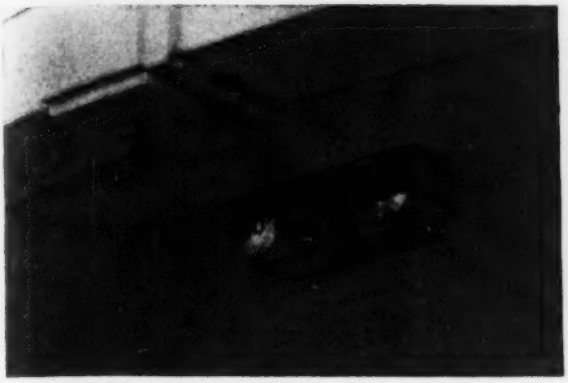
General supervision of all traffic is centered in the operating room of the Oakland portal building, where indicators and recording instruments show conditions of traffic movement to the chief operator. A duplicate set of instruments is installed in the operating room at the Alameda portal building for the purpose of informing the Alameda operator of changes in the traffic control. Each operator is, however, responsible for the operation of ventilating equipment in the respective buildings.

Seated at the desk control board shown in the accompanying illustration, the operator has before him a diagram on which lights indicate traffic movement in the tube, location of fire alarm boxes and telephone stations. Switches on the desk board allow the chief operator to set traffic signals at any point in the tube as required.

Push-button controls operate a siren on the entrance pylon and an electric gate similar to a railroad-crossing gate at the entrance to stop incoming traffic if necessary.



DOWNGRADE OF 4.5 PER CENT TO PORTAL BUILDING
Vehicles are required to maintain speed of at least 5 m.p.h. coming up this grade.



TRAFFIC SIGNAL SET IN TUBE CEILING
The usual "Go" and "Stop" signals have between them the yellow "Stop Engine" sign.

To secure proper co-ordination of traffic and ventilation, tachometers are also provided on the desk board to indicate the operation and speed of the eight fan motors in the building. Push-button controls can be used to increase the speed of the ventilating blower motors from the speed set by the automatic control.

The operating switchboard, located at the rear of the operating room, contains a series of graphic recorders which gives a continuous log of the operating conditions. Eight graphic recording tachometers in each portal building register the operation of the eight fan motors in the building. In addition, each switchboard contains eight non-recording tachometers operated from the motors in the opposite portal building serving as a check between the operators as to ventilating equipment in operation. In addition to the permanent record which they furnish these recorders were also installed to act as a check on the automatic control which nominally regulates the ventilating machinery by electric clock.

A graphic water-level indicator with chronograph pen records the time of operation of the motors for the central sump pumps which are located near the center of the tube approximately 1,800 ft. from the portal building. Another graphic instrument records the time of operation of the north- and south-bound traffic signals. Telltale lights are installed at each board to show the power service available at any time from the four independent sources of power.

The amount of carbon monoxide gas in the exhausted air is also shown by a graphic recorder registering on a scale calibrated from zero to 10 parts in 10,000. Adjustable contacts are provided in this instrument so that contacts may be made or broken at any desired points within range of the instrument, making it possible to operate motor-control apparatus and ring a bell if the percentage of gas rises above a predefermined limit. This limit has been established and maintained at 4 parts in 10,000.

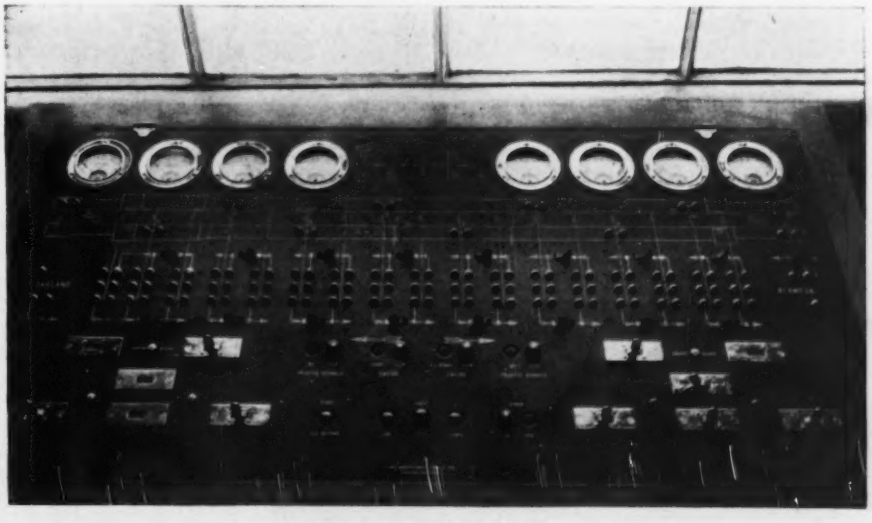
Traffic supervision in the tube is in charge of four traffic officers. A police officer of each city is stationed at the respective entrance of the tube and two deputy sheriffs patrol the tunnel proper on the elevated sidewalks. Each city would ordinarily have authority to the center of the tube, but by an agreement has delegated to the county supervision of all traffic within the covered portion of the tunnel and walled approaches. Traffic flows continuously without direction from the traffic officers unless a stoppage or accident occurs. In case of trouble the officer assumes control and personally directs the traffic, aided by traffic lights, which can be controlled from stations located at intervals through the tube.

Traffic lights shown in an accompanying illustration set in the ceiling along the center line of the tube at about 200-ft. intervals furnish the direct control visible to motorists. Under normal operation the green "Go Ahead" light shows and traffic moves, governed only by the speed limit. Any trouble which the traffic officer considers as temporary is relieved from the tunnel traffic station by changing all traffic lights to red from the entrance to the point of accident. The remaining lights stay green, permitting the traffic ahead to clear itself and the opposite lane to remain in service. Any such changes made by the traffic officer register by pilot lights on the operator's deskboard.

In case an automobile is definitely stalled the officer telephones for the county emergency truck stationed at the entrance and in the meantime directs traffic around the stalled machine. During any such period of stoppage, if, in spite of all the safety precautions, trouble should occur in the ventilating system, the operator will flash the yellow "Stop Engine" signal to prevent further contamination of the air until the fans are in operation again.

Illumination in the tube consists of a double line of 100-watt lamps with vapor-proof reflectors spaced opposite one another at 20-ft. intervals. The sidewalls and ceiling are painted white, giving an average light intensity of between 14 and 20 foot-candles.

The Oakland Estuary tube has now been in operation for more than four months and has not been closed since the formal opening. The average daily load of vehicles is about 13,000 per 24 hours, with an increase to about 20,000 on Sunday. Capacity of the tube, based on a



TRAFFIC CONTROL DESK IN PORTAL BUILDINGS
This board gives the operator a complete diagram of traffic movement, indicates the operation of the ventilating machinery and provides switches to control both.

20-m.p.h. speed with a 50-ft. interval, is calculated at 4,224 vehicles per hour, but the actual governing factor is the speed of the slow-moving cars and trucks on the upgrade. Even the allowable 5-m.p.h. speed on this grade will cause a temporary retardation of traffic if the lane is moving to capacity, and occasionally overloaded trucks fail to maintain the minimum speed. This retarding effect is accompanied by speeding of engines and the forcing of the following drivers to shift to a lower gear, producing temporary oil smoke and gasoline odors. Experience has shown that this temporary haze of oil smoke is the governing factor for the ventilating system and when this is taken care of the carbon monoxide content is automatically maintained far below the required limits of 4 parts in 10,000.

An unforeseen traffic-retarding influence is a boulevard stop" located one block beyond the Oakland entrance. This enforced stop is sufficient, under a full stream of traffic, to cause a retarding effect as far back as the portal. Temporary interruption to traffic caused by stalling of vehicles and driving accidents which require the services of the tow truck occur about 50 times per month. About 60 per cent of such towouts are due to motorists running out of gasoline. Among the other common trouble requiring the tow truck are overloaded trucks unable to climb the exit grade and mechanical defects which cause the stalling of vehicles.

Method of Laying Rock Asphalt in Cold Weather

Cold Material Heated in Cars by Steam Jets—Steaming Facilitates Both Unloading and Spreading

By William Speed
Louisville, Ky.

HANDLING and laying cold rock asphalt in cold weather have been solved in recent road construction by the tools and methods described here. The illustrations of the tools were secured on street work at Louisville, Ky., by F. C. Breslin, contractor, and the methods described are those of A. H. Hinkle, superintendent of maintenance, Indiana State Highway Commission.

Being shipped and laid cold, the rock asphalt is first made friable for unloading by a steaming process. Fig. 2 shows the outfit for steaming. Holes are punched through to the floor of the car with a pointed piece of steel ¾ in. in diameter. These holes are placed approximately 2 ft. from the side of the car and 4 ft. apart. Pieces of ½-in. pipe 4 ft. long, open at the lower end and attached to a steam hose at the other end, are inserted into the holes and live steam is turned in. The number of steaming nozzles used will be determined by the speed with which it is proposed to unload the car.

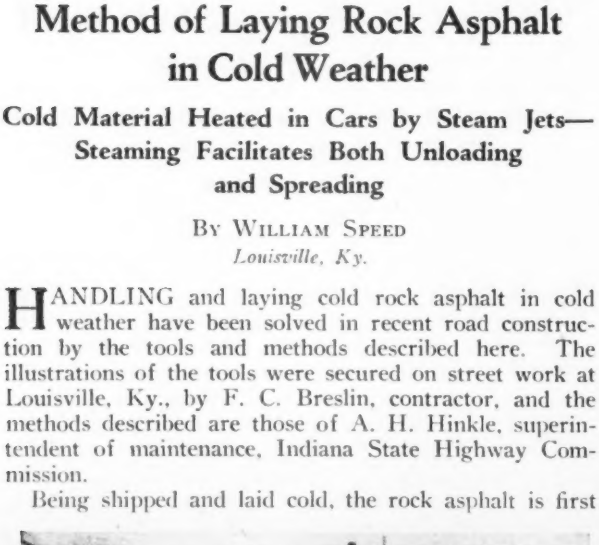


FIG. 1—GAGE STRIPS AND LUTES FOR SPREADING ROCK ASPHALT

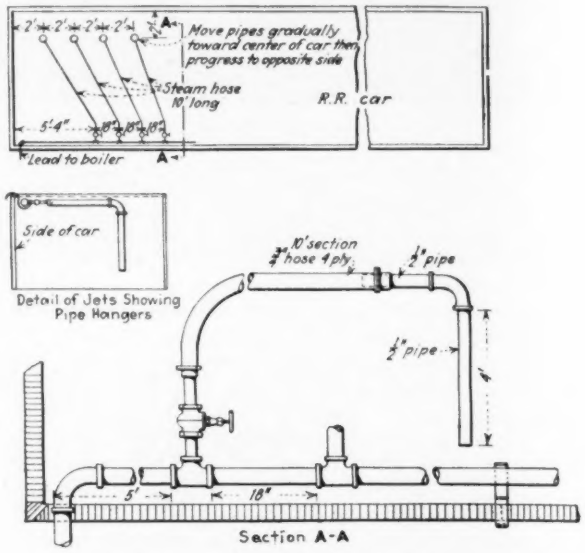


FIG. 2—OUTFIT FOR HEATING ROCK ASPHALT IN CARS

When unloading by hand shovels four such nozzles are sufficient, they being moved ahead of the shovels as the unloading progresses. The steaming operation should start at least 2½ hours before beginning to unload.

The steamed asphalt is dumped by trucks to the prepared base and shoveled into place. Metal strips $\frac{3}{16}$ in. thick, 2 in. wide and 16 to 18 ft. long, bent at right angles near one end to prevent them from tipping over, are laid 3 ft. apart, parallel to the center line, on the base.

The asphalt is brought to grade by a 3-in. triangular lute 3½ ft. long, worked back and forth over the metal strips, which are dragged ahead as the spreading and luting progresses. A 4x4-in. square lute 5 ft. long with a 10-ft. handle is used at right angles to the center line behind the foregoing operation. This cross-luting removes the slits left by the metal strips and otherwise aids in obtaining a smooth surface. The depth of the strips should be ¼ in. less than the loose thickness of the asphalt, because of the fact that it is practically impossible to finish the base to true grade.

The lutes with which the asphalt is leveled to the top of the metal strip are made of 3x3-in. oak 3½ ft. long sawed diagonally and the 10-ft. handle is attached at angle so that the face of the lute can lie flat on the strips without making the operator bend his back. By raising and lowering the handle in the forward and backward stroke, the cutting edge comes in contact with the asphalt. The finishing drag, which is used at right angles to the center line of the street after the metal strips are slid ahead, is made of 5x5-in. oak 6 ft. long, with a suitable handle 12 ft. long.

Water for Hendersonville From Pisgah National Forest

Outline of Works and Earlier and Later Regulations of U. S. Department of Agriculture for Use of the Forest

By Preson P. Phillips

Designing Engineer, Gilbert C. White Company, Durham, N. C.

IT IS the policy of the U. S. Department of Agriculture, which has charge of all national forest areas, to utilize and develop all forest resources as fully as is consistent with watershed protection and timber production, for which such forests were established. It considers the use of these areas for public water supplies one of the most important uses to which they can be put.

The Pisgah National Forest comprises approximately 275,000 acres of heavily forested mountains in western North Carolina and eastern Tennessee. These mountains, having an annual rainfall of about 60 in., are the source of many streams, the drainage areas of which are protected by the sanitary and fire protection regulations of the Forest Service and are also systematically reforested. They therefore offer ideal sources of water supply for cities near enough to make use of them, furnishing an unusually pure, cold, mountain water which can usually be delivered by gravity and needs no filtration.

Supply for 20,000 Necessary

Hendersonville, the county seat of Henderson County, is located on a plateau just west of the Blue Ridge Mountains of North Carolina, at El. 2,200 ft. above sea level. The permanent population is about 10,000, but during the tourist season more than 20,000 people have to be cared for.

The original water-works for Hendersonville, consisting of a small reservoir fed by streams, was constructed in 1888. This proving inadequate, in 1918 it was replaced by a filtered supply pumped from a small stream near the town. In 1921 this supply was found to be much too small, and the Gilbert C. White Company was employed to make recommendations for a new supply and to design and supervise construction. Investigation proved that the most logical source of supply was the north fork of Mills River just below the junction of Big Creek and Fletcher Creek, about 16 miles from the city. The drainage area at this point was 10½ square miles, all within the Pisgah National Forest. From a 5-m.g. intake reservoir at El. 2,450 a 16-in. cast-iron pipe was laid 16 miles to a new 5-m.g. distributing reservoir built within the city at El. 2,335, about 200 ft. above the business district of the city. The normal capacity of the creek and pipe line was estimated at 2.18 m.g.d., with a minimum dry-weather flow of 1.12 m.g.d., and it was estimated that this should take care of the city for five years.

This water supply being entirely within the Pisgah National Forest, as was also a good part of the pipe line, it was necessary for the city to obtain from the Department of Agriculture permission to take water from the creek, build a dam and lay the pipe line. Such a permit was obtained in May, 1922, to include also Wash Creek, on the north fork, and Bradley Creek, on south fork of Mills River. The essential conditions of this permit obtained from the Department of Agriculture were as follows:

1. All regulations governing the forest and game preserves must be complied with by all employees of the city; and all sanitary regulations proposed by the city in accordance with the laws of the State of North Carolina must be observed.
2. Grazing of domestic animals, camping and construction and occupation of buildings not needed by the city or the Forest Service for the protection and administration of the land will not be permitted.
3. The Secretary of Agriculture agrees to allow no timber to be cut or removed that would hurt the water supply and to extend and improve the forest upon this land by seeding, planting, etc.
4. The city agrees to cut and remove no timber from the water-supply area without permission of the Forest Service, and to pay for all timber removed with permission.
5. The city is given permission to build a fence around the exterior boundaries of the land, providing gates are left at points to be designated by the Forest Service for its use, so as not to interfere with its care and inspection of the property.
6. The city agrees to protect and repair all roads, trails and other forest improvements during the construction of its dam and pipe line if used by it.
7. The city agrees to pay to the Department of Agriculture $750 per year for the use of the 10½ square miles of government land within the watershed of Big Creek and Fletcher Creek; $220 per year for the 2.75 square miles at the head of Wash Creek and $430 per year for the 6 square miles at the head of Bradley Creek, the payments for Wash Creek and Bradley Creek not to begin until the city uses the property. In addition to the above the city is to pay $5 per mile or fraction thereof for the land used for the pipe-line right-of-way.
8. Readjustment of annual rental is to be made at the end of 30 years and every twenty years thereafter, the amount of increase in rental not to exceed 25 per cent of the previous period, but the Forest Service to have the right to add 3 per cent interest on the value of forest products, the sale of which is prevented by this contract.
9. The city may not transfer its rights and interests except with the consent and approval of the Secretary of Agriculture, who at such a time has the right to revise this agreement.

The intake dam on Big Creek and the 16-in. pipe line to the distributing reservoir in Hendersonville were completed in January, 1924. The water obtained was pure and required no treatment, but a chlorinator was installed at the distributing reservoir and the water was chlorinated as it passed into the distributing system.

Terms of New Agreement

Between January, 1924, and the latter part of 1927 the consumption of water in the city of Hendersonville increased more than 300 per cent and the city again found it necessary to increase its water supply. On the advice of the Gilbert C. White Company it was decided to use the watershed area of Bradley Creek, but in view of the fact that the population was increasing so much faster than had been anticipated as natural, the Department of Agriculture was asked to increase the watershed area allotted to the city on this creek from the original 6 to a total of 10.9 square miles, which necessitated a new agreement with the department, which in the meantime had revised its code for such a permit. The essential conditions of the new contract were as follows:

1. Permit is issued for the city to use all areas required free of charge under the authority of Regulation L-2 (*h*) of the National Forest Manual.
2. The city has the right to use any or all of the water in these watersheds over which the Department of Agriculture is vested with authority, but is not granted the right to take water as against any riparian owner other than the United States of America.
3. The Secretary of Agriculture reserves the right to require the city of Hendersonville to allow any adjacent community to obtain water from this source of supply upon such terms as he considers reasonable, provided that there exists a surplus over and above the needs of the city, and provided that no other sources of water supply are available to said community at a reasonable cost, and provided that these adjacent communities will be allowed to use this surplus water only so long as such surplus exists.
4. The intent and purpose of this permit is to provide for the

complete and orderly development and use of the watershed by the city in successive stages as needed, following the detailed plan of development adopted by the city. As a general rule the following requirements will be met by the city:

(*a*) The present storage system and pipe line on the north fork of Mills River shall be kept in readiness for use at all times.

(*b*) A 20-in. pipe line from the point of diversion on Bradley Creek shall be laid to intersect the 16-in. pipe line from the north fork of Mills River and put in operation prior to Sept. 1, 1928, or as soon as completed.

(*c*) A storage dam, materials and design satisfactory to the forest supervisor, and located on Bradley Creek at El. 2,390 ft. above sea level to flood approximately 40 acres, will be constructed as soon as needed by the city.

(*d*) Further stages of construction required for the completion of the development of the watersheds, including the impounding of water on Fletcher Creek and the laying of additional pipe lines from Wash Creek or other points included in this permit, shall be undertaken as the water requirements of the city of Hendersonville and the territory served by its water supply make these developments necessary.

Timber-Cutting Restrictions

5. The city shall not cut or remove any timber from the watershed, except with the written permission of the forest supervisor; provided, however, that all timber and brush below the shore line of the reservoir site and along the pipe-line right-of-way, confined to a strip 10 ft. wide on either side of the center line, are hereby designated for cutting. No timber or brush above the shore line, including islands or elsewhere, shall be cut, unless marked or designated by the forest supervisor. Merchantable timber or forest products which are cut shall be paid for at prices current in government timber sales, whether used or not, but all timber so cut shall be removed from the permitted area and the national forest. No charge will be made for unmerchantable timber or forest products. Brush, tops and débris resulting from the cutting shall be piled for burning, under the direction of the forest officer in charge.

6. No burning of timber or brush will be allowed without written permission of the forest supervisor at times and places to be designated by him.

7. The Forest Service will continue its standards of fire prevention on areas, any additional protective measures deemed necessary by the city to be paid for by it.

8. The city to be liable for costs of suppression and damages from all forest fires originating from its operations and those of its employees and contractors, and in case of fire the entire force of the city or contractor in the area and available shall be used to fight such fire; the city to pay the costs of such fire fighting.

9. Each locomotive or boiler used in the area, burning wood or coal, to be equipped with spark arrester satisfactory to the forest supervisor. The ground around any stationary boiler to be cleared and kept cleared for a distance of 300 ft. in all directions, and railroad rights-of-way to be kept free from any inflammable material for a distance of 100 ft. on each side of the center of the track.

10. No charge to be made for earth, stone and sand from the area, if used in the area, but these to be taken only from the places to be designated by the forest supervisor, and if removed from the national forest to be paid for. Cuts, fills and borrow-pits to be smoothed up and left in neat condition satisfactory to forest supervisor.

11. The city may fence in the area of the reservoir at a distance not to exceed 25 ft. from the high-water mark, but gates and passageways must be provided for the personnel of the Forest Service at points to be designated by them. The forest supervisor shall also have the right to operate any boats on the pond necessary for the supervision of the area.

12. The city shall repair, replace or move any improvements, including roads and trails rendered useless by its operations, and shall maintain all roads used by it during its construction operations.

13. Signs used by the city in the area will be of material, size and design to be approved by the forest supervisor.

14. This permit carries no authorization to hunt or fish on the area except in accordance with rules and regulations of the Secretary of Agriculture, and the city agrees to discharge any employee who breaks these rules. It is prohibited to carry firearms on the game preserve except under written permit from the forest supervisor.

15. The city shall allow sufficient water to pass from its diversion dams to maintain fish life in the stream as required by the forest supervisor.

16. The city shall install suitable gages in all reservoirs, gaging stations below storage and diversion dams, and meters in all pipe lines near the point of diversion. All the records of the city pertaining to the construction, maintenance and operation of the water system shall be open to inspection at all reasonable hours by the forest officers. The information so obtained will be regarded as confidential.

17. No commercial concession of any kind shall be let or operated by the city on the lands included in this permit, except under special permit issued by the Forest Service. The Secretary of Agriculture reserves the right to allow use of allotted area under the regulations of the department, when such uses are determined by him not to be in conflict with this permit.

18. All dams, spillways, pipe lines, caretakers' dwellings and other structures erected on this area to be approved as to design, materials and construction by the Forest Service.

19. Hydro-electric power not to be generated unless further authorization is obtained.

20. Camping on or construction of buildings not needed by the city or Forest Service on areas will not be permitted.

21. This permit shall terminate only on breach of some of its conditions, but it may be modified at any time to place it on a basis consistent with conditions required of other permittees for like privileges.

22. If permit is abandoned, structures may be removed within a reasonable period to be specified by the forest supervisor, except where materials were furnished by the Forest Service, but upon failure to remove structures within this time, they shall become the property of the United States.

Under this permit the city of Hendersonville is constructing a small concrete intake or diversion dam on Bradley Creek, to impound water at El. 2454, and is laying a 20-in. cast-iron pipe line to connect with the present 16-in. main from Big Creek.

In arriving at the size and character of the pipe line to carry water from the new intake dam to the city, it was necessary to consider several combinations in order to arrive at the best and most economical one for the city at this stage of development, at the same time keeping in mind the ultimate development of this area, using a high storage dam placed farther down the creek to impound water at the same elevation. Diagrams for all possible combinations of 20- and 16-in. pipe and high and low dams were drawn, and it was decided to lay a 20-in. line, 34,900 ft. long, from the dam to connect with the present 16-in. main at Big Creek. The normal flow of water to the city using this combination will be 2.8 m.g.d., with a minimum draft of 2.66 m.g.d., taking water from both reservoirs. This draft yield cannot be increased, and when the city's requirements exceed this amount, a storage dam must be built on one of the watersheds, additional watershed area must be called on, or a new storage reservoir must be built near the city. By paralleling the present 16-in. main from its junction with the new 20-in. main with a new 16-in. main to the city, the normal yield from these watersheds can be increased to 4.77 m.g.d. The ultimate development of this creek will be a storage dam with such a pipe line, and this will provide a draft yield of 3.7 m.g.d.

Additional Areas Available

The city of Hendersonville now has allotted to it by the Department of Agriculture about 24 square miles of well-forested watershed area having an annual rainfall of about 60 in. The present development contemplates only gravity supplies taken from points well up toward the heads of the creeks, but by building impounding dams at points farther down the creeks and pumping the water thus impounded through additional pipe lines, this area can be made to yield up to 20 m.g.d. If and when it is necessary to exceed this amount, there are additional areas that the Department of Agriculture will allot to the city.

The present work is being done under a board of water commissioners consisting of C. E. Brooks, K. G. Morris, J. W. Bailey and J. H. Lampley, managers. The Gilbert C. White Company, of Durham and Charlotte, is the consulting engineer; V. B. Higgins & Company, of Charlotte, is the contractor; and R. B. Gandy is the resident engineer.

American Society of Civil Engineers Holds Spring Meeting in Dallas, Texas

Engineering Problems of the Oil Industry Chief Interest of the Convention—Highways, City Planning, Irrigation Highways and Sanitation Considered by Division Meetings

PROBLEMS of the petroleum industry of an engineering nature featured the two-day technical sessions of the American Society of Civil Engineers at the spring meeting April 24, 25 and 26 at Dallas, Tex. Five divisions held meetings with specialized papers on the second day. Highways, sanitation, city planning, irrigation and surveying and mapping were the divisions represented. The petroleum topics related to deep well practice and oil and gas line construction, both close to the civil engineer's field. A clear outline of the geochemistry of petroleum was presented by R. B. Whithead, chief geologist, Atlantic Oil Producing Co. The deep well paper was presented by W. W. Scott, petroleum engineer, Humble Oil and Refining Co., and the pipe line paper by E. C. Kinkade, vice-president, Gulf Pipe Line Co.

Discussion on Oil and Gas Pipe Lines—Discussing the paper on oil and gas pipe lines, F. Ray McGrew, president, Standard Pipe Line Co., Inc., Shreveport, stated that despite the trend to welded pipe for oil, screwed construction has many advantages. He preferred the latter for oil but he felt welded lines were better for gas. In either construction the most important phase is ditching which, if properly done, relieves the line from stress and strain and danger of "pull-aparts." Fifty miles is too far apart for stations in his opinion; 38 is a maximum. With "looping" the 38-mile limit increases capacity.

F. L. Chase of the Lone Star Oil Co. agreed with Mr. Kinkade on the trend to welded lines for gas lines. In three years his company laid 1,500 miles of welded pipe from 30-in. size down. Of a total of 4,000 miles of trunk and service lines only twelve cases of trouble arose.

In answer to questions Mr. Kinkade said rifling had no standing, costs of welded and screw pipe were the same and flow characteristics showed no detectable difference.

Mr. McGrew answering a query said that the procedure to take where pipe lines cross waterways is an individual problem and a function of river characteristics. Usually it is best practice to use double weight pipe. Both welded and screwed joints are protected by heavy cast-iron river clamps to stiffen the joints. The clamp weight anchors the line to the bottom. In rock bottom anchor hooks are let into drilled holes. In silt bottom the pipe sinks and anchors itself. The most important phase of river construction is provision for slack on the banks, as there is a tendency of the line to feed into the river, sometimes for 20 years. The approach line should have a snaky trace to provide this slack. Mr. Chase believes in pipe line bridges which are usually no more expensive than bottom crossings with maintenance nil except for painting.

Highways—O. E. Carr, city manager, Fort Worth, in his paper on "The Equitable Distribution for Highway Purposes of Motor Vehicle License Fees and Gasoline Tax" made a plea for the expenditure of more tax money in the cities from which heavy collections are made to be spent in the country. He advocates the Ohio distribution plan giving to the local taxing district one-half the license fees for streets and roads and 30 per cent of the gasoline tax for city streets only.

In "Highway Location Problems," a topic covered by Gibb Gilchrist, Texas state highway engineer, the main plea was for economics and engineering principles to govern.

A. R. Losh, district engineer, U. S. Bureau of Public Roads, covered the same subject in a fundamental way from the standpoint of relocation effects, restrictions, economics, topography, congestion, grade separation and bypassing. An abstract of his paper is planned at a later date.

Tyree L. Bell, Corsicana, Tex., in his paper on "Concrete Road Building Plant and Its Operation," stressed road building as a quantity production procedure requiring close study of plant assembly. Everything should be keyed to the mixer unit. Fewer men are needed but better ones can well be afforded.

Organization in City Planning

City Planning—This division had a concentrated program of two papers relating to preparation and organization for city planning as related to large cities by Alex. F. Weisberg, chairman, Dallas City plan commission and as related to small cities by E. A. Wood, consulting engineer, Dallas. The former stressed the point that desirable and difficult as is the formulation of a plan the great problem was to protect it and get it followed.

Mr. Wood outlined the problems to be taken up and how to meet them in a small city for which he stated that the principles were the same though it is easier, more effective and less costly than in a large city. Also more prevention and less corrective measures need be taken.

In discussion A. P. Rollins outlined the present status of the plan under which Dallas in 1927 voted $23,900,000 for recommended improvements. Especially important has been the work of a co-ordinating committee of engineers appointed by the city, county and levee district officials to co-ordinate the plans and activities of the three agencies.

O. H. Koch, consulting engineer, Dallas, indicated certain phases that were harder to work out in smaller cities (under 50,000) than larger ones. A shorter "base line" is available from which to predict future growth; a single industrial acquisition may wholly upset the plan and unbalance the facilities. Density is less. Not so much need is evident for close business zoning. Plans should be simple. The capitalized cost of preventing errors may not be more than cost of corrective measures later in the mapority of cases.

John L. Starkie, Brownwood, Tex., suggested that the railroads would welcome the use of standard symbols by city planners in showing different zoned areas.

Sanitation—Four papers dealt with sanitary engineer-

ing, three relating to local Texas plants and the fourth on cost distribution between collection and disposal of sewage so far as operation and maintenance is concerned.

Features of the San Antonio 30-m.g.d. activated sludge plant for an expected 85 per cent increase in the present 16.4 m.g.d. flow from 220,000 people (connected) and for which contract was recently let were described by H. R. F. Helland, associate engineer with Hawley & Freese, who designed the plant and are supervising its construction. Essential units include ½ in. screens, the screenings to be burned in an incinerator fired from gas collected over the sludge digesters; grit chambers in which the velocity is 1 f.p.s.; 30-min. clarifier in two tubes, 60 ft. square; six aerator units arranged in batteries of three channels 20 ft. wide and 15 ft. deep with the sewage flowing back and forth 450 ft. for a 5-hour period with air applied at the rate of 1½ cu.ft. per gallon of sewage; final clarifiers of two hours capacity, 90 ft. in diameter and 15 ft. deep with flow from center to periphery, and four 45-day storage sludge digestors, 75 ft. in diameter and 25 ft. deep covered with domed gas collectors. The effluent goes to Mitchell Lake, a small artificial body of water, thence to the Medina and San Antonio rivers or it may be used as now for irrigation.

M. C. Nichols in discussion stated that one wall between two 20-ft. aerator channels had been omitted to determine what effect would result. S. A. Greeley said that the plans for the New Ward Island (New York City) plant would call for 22-ft. width as a result of favorable operation at Chicago with 35-ft. width.

Sewage Disposal in Texas

East Texas experience and practice with sewage disposal was outlined by H. L. Thackwell, consulting engineer, Jacksonville, Tex. Oxygen deprived, polluted streams in hot dry summer months cause real nuisances but low limits in bonding power make relief difficult. Separate sludge digestion with insulated tanks has been given a fair trial as have degasification and partial pressure digestion. Reaction treatment and dosing of sludges together with decantation and air agitation has geen attempted. Glassovers are used satisfactorily in three plants. Decanted liquor from sludge beds is filtered through sand. No activated sludge plant has yet been built but most other types are represented.

W. S. Tanner, engineer with the sanitary sewer department, Dallas, read a paper on "A Proposed Equitable Distribution of the Cost of Construction, Maintenance and Operation of Sewage Collection and Disposal Systems." Financing construction through the sanitary district method on assessment of benefits and damages is now possible under Texas law. For cost of maintenance and operation of the collection system the distribution is made in theory on the basis of quantity and degree of pollution with rates fixed on a similar basis to that used in fixing water rates except that the sewage department rate is based also on the cost of purification of the sewage to be collected and disposed of. Ground water and wastage complicates the matter. The city is divided into districts the flow from which is metered. The minimum daily flow in dry weather is charged to ground water. The balance is charged to the fixtures in the district according to quantity and quality as noted below:

Fixture	Quantity Gal. Per Day	Per Cent	Biological p. p. m.	Oxygen Demand, Per Cent	Combined Per Cent (Equal Value)
Toilets	32	39	680	79.0	59.0
Bath tubs	23	28	30	3.5	15.8
Lavatories	7	9	50	5.8	7.4
Sinks	20	24	100	11.7	17.8

Collection system construction costs are allocated to assessment. Collection system maintenance and operation are divided between domestic and industrial users on the basis of quantity, with the domestic users assuming the additional burden of infiltration which occurs mainly in laterals. Disposal system construction maintenance and operation is divided between domestic and industrial users according to the relative quantities contributed and relative oxygen demand, no assessment for benefits and damages being made. The quantity ratio is 80 per cent domestic and 20 per cent industrial while the B.O.D. is 33 per cent to 67 per cent respectively, or giving equal weight the domestic consumers are charged 56.5 per cent and the industries 43.5 per cent. As worked out in detail the toilet annual rate becomes $1.66; bath tubs $0.80; lavatories, $0.28; sinks, $0.89. A rate was found at 8c. per 1,000 gal. for industrial wastes for quantity and 6c. for the average B.O.D. requirements.

George M. Ames, Grand Rapids, Mich., said that since the meter basis of charge in his city had been voted down a committee of engineers had recommended a $3 service charge and then the water meter basis which figures out about $6 total for the average household.

W. S. Mahlie, chemist in charge of water and sewage purification, Fort Worth, described the enlargement of the capacity of the sewage treatment works of Fort Worth to care for 16 m.g. of sewage and packing house waste equivalent to 195,000 population. The old Imhoff plant cared for the domestic sewage but could not treat adequately the additional load of the packing house waste. Essentially the plant is tripled in capacity by adding activated sludge units between the Imhoff tanks and sprinkling filters to care for the combined raw sewage having a B.O.D. of 525 p.p.m. Other existing units of the plant are also increased in capacity.

In discussion S. W. Freese of Hawley & Freese, the consultants, stated that examination of the split tile underdrains were in such good shape the same type was used for the new units. S. A. Greeley spoke of operating results during September, 1928, at Decatur, Ill., after which the Fort Worth plant is patterned, indicated a B.O.D. in raw sewage of 172 p.p.m. reduced 20.8 per cent by the Imhoff tanks, 43.2 per cent by the activated sludge units, 91.1 per cent by the sprinkling fillers and final settling tanks, giving an effluent with B.O.D. of 14 p.p.m.

Irrigation Problems of Southwest

Irrigation—In the Irrigation Division were four papers; one by L. M. Lawson on boundary work is noted elsewhere. Irrigation work done by Mexico was outlined by Dr. Ignacio Lopez Bancalari, director, Irrigation Commission, Mexico. "Silting and Life of Southwestern Reservoirs" was discussed by R. G. Hemphill, irrigation engineer, U. S. Department of Agriculture.

Ernest L. Myers, consulting engineer, Dallas, spoke on "Drainage and Seepage Prevention in the El Jardin District." This coastal plain area is just east of Brownsville and has been cut through by loops of the Rio Grande. The old abandoned bed of the river has been used as canals in places but later canals were built on the banks. Leakage seeped the land badly. Drainage has reduced the ground level and canal lining cut down seepage so that the lands are being reclaimed.

Miscellaneous Papers—Engineering problems of the International Boundary Commission, United States and Mexico, were outlined by L. M. Lawson, commissioner. He traced the history of the commissioner's work down

to the present and noted the latest proposal of another dam below Elephant Butte on the Rio Grande to reduce floods by El Paso and straightening of the river by cutting across bends, reducing a stretch of 155-mile river distance to 88 miles. Fall will be increased from 1.82 ft. per mile to 3.2 ft. and the accelerated velocity resulting is expected to scour out the sand and sediment deposits that have been so marked since the Elephant Butte dam was built. The plan is agreed upon by both sides of the commission and recommended to the two governments.

B. F. Williams, Texas state reclamation engineer, read an interesting paper on "Relocating Land Surveys in Texas" in which he described the early surveying history of Texas, its Spanish background and peculiar customs of ancient origin. Many valuable hints to young surveyors on his experiences and those of the early surveyors were given. This is particularly true as to identifying tool marks on trees.

Excavating New Million-Yard Channel for the Chicago River

Buried Obstacles and Scow Disposal Require Dipper Dredges—Special Discharge Barge Enables Hydraulic Dredge to Load Scows

THE straightening of the Chicago River, which is now well under way south of the loop district and in the midst of the vast network of railway tracks from the south, involves about a million yards of new channel excavation, an equal volume of fill of old channel and about 9,000 ft. of dock wall as major items. The excavation is dredging complicated by many buried obstacles and by restricted working space under bridges and alongside railway tracks carrying traffic. There was the necessity also of removing all excavation by scow. Therefore the problem of working out an equipment plan which would meet exceptional and varying dredging conditions was important. As developed the plan has some unusual features.

Construction Required—The work to be done includes a new channel about 4,700 ft. long and 200 ft. wide with 26-ft. depth of water. It is to be lined on both sides by pile and timber dock wall capped with concrete to 3 ft. below water. When navigation is turned into the new cut, the present channel will be filled in. The contract was signed Aug. 18, 1928, and orders to begin construction were issued Sept. 27.

The approved schedule calls for opening the new channel to navigation Oct. 1, 1929. The filling of the old channel and the completion of the docks on the east side of the new channel at the north and south ends, where they are involved with rearrangement of railroad facilities, will be completed as early in 1930 as conditions will permit. The total or contract amount of the river-straightening work, which is being done on a unit price basis, is estimated at approximately $2,773,930. This of course does not include the expenses of the various railroads in connection with the project. The main contract quantities are as follows:

Earth excavation, cu.yd.	950,000
Rock and old concrete excavation, cu.yd.	3,000
Dock wall of various types, lin.ft.	9,070
Channel and top fill, cu.yd.	1,000,000
Concrete sewer, 3, 4 and 8 ft., lin.ft.	2,170

The plan, Fig. 1, is reproduced from *Engineering News-Record*, Nov. 4, 1926, p. 745, where a general description of the project was published with drawings of the dock walls.

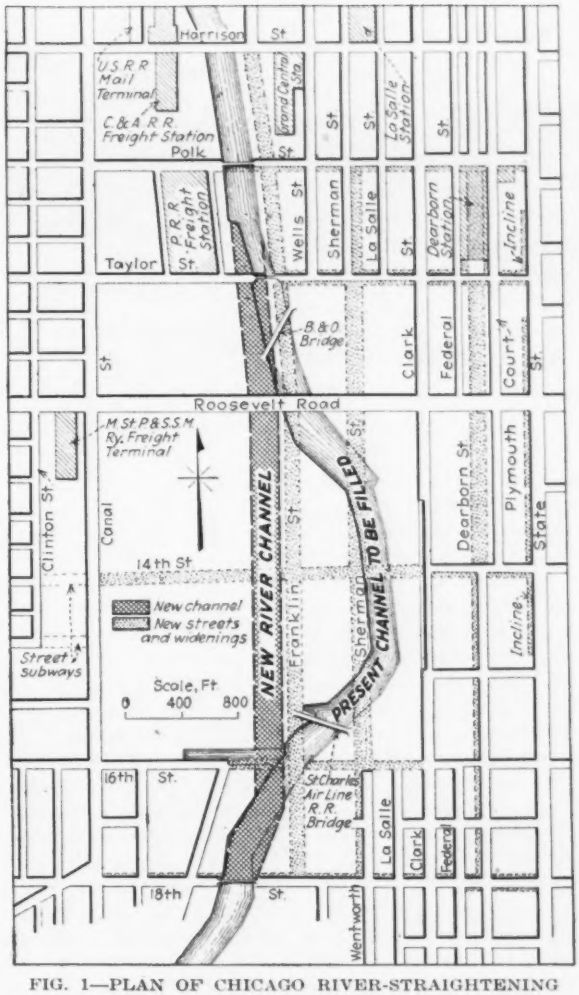


FIG. 1—PLAN OF CHICAGO RIVER-STRAIGHTENING PROJECT

Object of Improvement—The purpose of the river straightening is to get rid of a sharp bend which begins just south of Polk St. in the downtown district and continues to almost Eighteenth St., or about a mile to the south. In this distance the present river at about Fifteenth St. comes within 150 ft. of Clark St., necessitating the crowding of railroad tracks, etc. The new position of the river will be about about 850 ft. farther west of Clark St. Therefore, in effect, the straightening transfers a considerable amount of cheaper land from the west side to the more important south side of Chicago and the increased value of the land, purchased by the railroads under the city ordinance, finances the cost of the work.

This allows the railroads to rearrange and modernize their facilities, including dock terminals, etc., but, equally important, it allows the opening of four north and south streets and one east and west street through the area formerly held solidly by the railroads just south of and slightly west of the so-called loop district. The need of these additional streets, particularly the new north and south streets, is great. Wabash Ave. and State St. are practically the only through commercial streets on the south side at present, Michigan Ave. being for restricted traffic and Clark St. being too narrow for trucks and

FIG. 2—LOADING SCOW FROM HYDRAULIC DREDGE DISCHARGE

also too hilly on account of up and down grades to and from higher streets.

General Construction Plan—It is the general plan to conduct the river-straightening work from both ends of the improvement, but the most progress to date has been made from the north end, as the site at the south end has not been wholly available, although a good start has been made on both dredging and docking at the extreme south end. A considerable number of foundations of heavy old buildings, railroad pits and sheet piling remaining from an old river slip and other obstructions have been so far encountered in excavating the north 1,000 ft. of the new channel. Drilling and blasting were required to break up the old masonry, after which the foundation piles, grillages, etc., under it were removed with derrick boats before the dredges could work. Dipper dredges have been used wherever possible, because they are considered the most positive way of excavating obstructions.

Hydraulic Dredge Work—The most unusual operation has been to excavate a narrow cut under the new Roosevelt Road bridge which has been built across the new channel area in anticipation of the river-straightening work. The west pier was built in the dry and the east pier was built in the wet at the west side of the present old river. Fig. 4 shows the west leaf of the new bridge with relation to the new channel being constructed at that point. The partial width of channel was excavated by working nights with the bridge leaf up to clear the outfit, as the street-car line over this bridge is important, carrying 100,000 persons every day.

On account of the B.&O.C.T.R.R. requiring the space under the east leaf of the new bridge in order to run into its depot at Harrison and Wells Sts., the channel under Roosevelt Road bridge is restricted to 74 ft. at its narrowest point. This width is temporary, but will continue until the new channel is completed and navigation is turned into it; after the railroad crosses the old river on trestles, the new channel can be widened to full width by excavating under the east leaf where the railroad tracks are now.

These conditions made it impracticable to use dipper dredge methods in this stretch of the work, as there was not sufficient space for the combined width of a dredge with a dump scow alongside for loading. Also a pilot cut would first be necessary, requiring rehandling. So the experiment was tried of using a hydraulic dredge in this rather difficult material, which is blue clay contain-

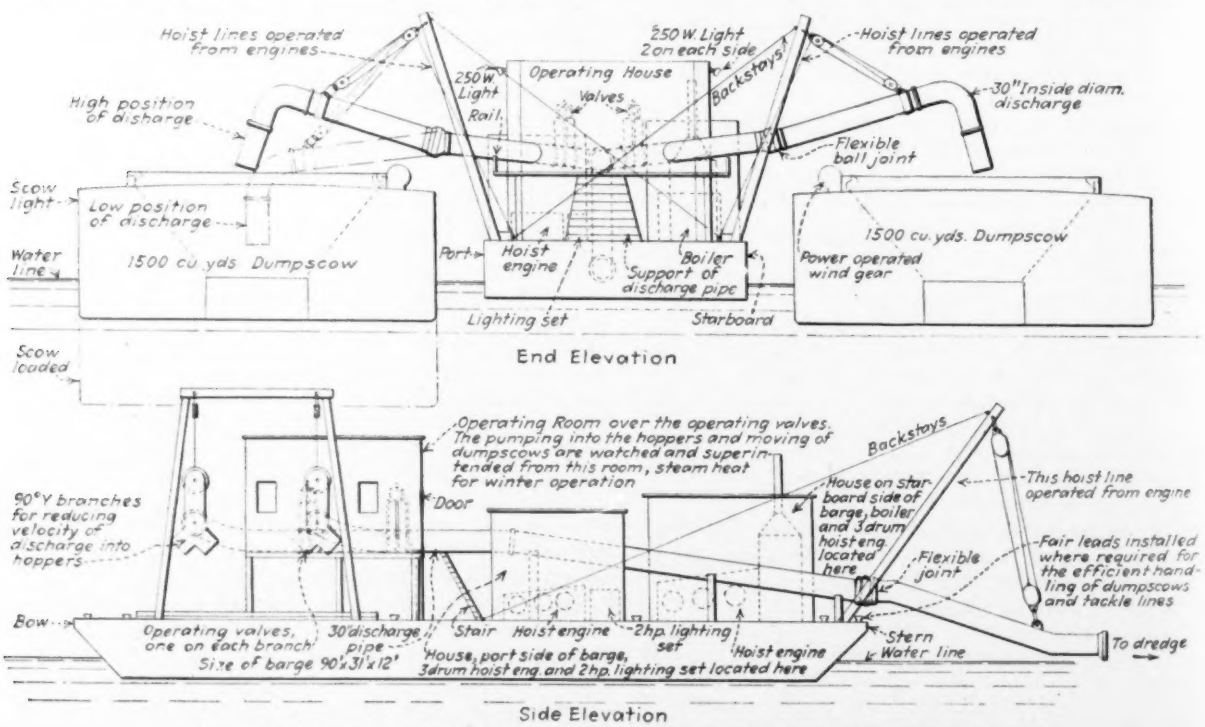

Hoist lines operated from engines
250 W Light 2 on each side
Hoist lines operated from engines
250 W Light Rail
Operating House
Valves
Backstays
High position of discharge
30" Inside diam. discharge
Flexible ball joint
Scow light
Low position of discharge
Water line
1500 cu. yds. Dumpscow
Port
Hoist engine
Boiler
Support of discharge pipe
1500 cu. yds. Dumpscow
Power operated wind gear
Lighting set
Starboard
End Elevation
Scow loaded
Operating Room over the operating valves. The pumping into the hoppers and moving of dumpscows are watched and superintended from this room, steam heat for winter operation
Backstays
90° Y branches for reducing velocity of discharge into hoppers
Door
House on starboard side of barge, boiler and 3 drum hoist eng. located here
This hoist line operated from engine
Flexible joint
Fair leads installed where required for the efficient handling of dumpscows and tackle lines
Bow
Operating valves, one on each branch
30" discharge pipe
Stair
Hoist engine
2 hp. lighting set
Stern
Water line
To dredge
Size of barge 90'x31'x12'
House, port side of barge, 3 drum hoist eng. and 2 hp. lighting set located here
Hoist engine
Side Elevation

FIG. 3—DISCHARGE BARGE FOR LOADING SCOWS FROM HYDRAULIC DREDGE LINE

ing considerable débris, consisting of large and small stone, old timber, planks, old iron rods, etc.

After passing the bridge the dredge will cut to the full 200-ft. channel width so that dock operations at each side of the new channel may be commenced. The time required for dock construction is the heaviest part of the schedule, and if winter weather is not too severe, both the dredging and dock work will be pushed as far south as possible but not so as to interfere with the new B.&O.C.T.R.R. and the Illinois Central Railroad bridge substructures, etc., being built across the new channel in the dry north of Sixteenth St.

Dredge Pumping to Scows—Because of the railroads at both sides, the material excavated for the new channel cannot be stored at or near the site for filling the old channel after navigation is abandoned in it, nor can the material be disposed of in railroad cars, because of congestion. The experiment was therefore tried of pumping

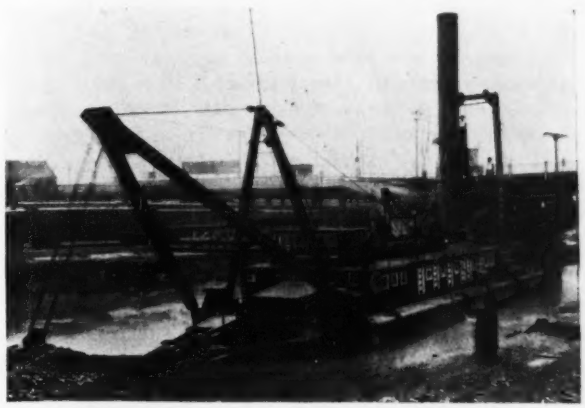


FIG. 4—HYDRAULIC DREDGE PUMPING TO SCOWS AT ROOSEVELT ROAD BRIDGE

the material dredge by the hydraulic unit into large steel dump scows of 800- to 1,500-cu.yd. capacity, such as are generally used for large dipper dredging operations.

Fig. 2 shows this process in operation. Empty dump scows are lashed in turn to the discharge scow (Fig. 3), located at the discharge end of the pontoon line carrying material excavated by the hydraulic dredge. The 24-in. diameter discharge line from the dredge is there divided into two Y's, each capable of loading a dump scow at its side of the pump scow. These branches or delivery pipes are made of large section to reduce the velocity of the pumped water carrying the dredge material at the delivery end, and accordingly very little of the excavated material is washed out of the pockets of the scows. One pocket is loaded at a time, as in dipper dredging work, the dump scow being moved downstream along the discharge scow as loading progresses. Loaded scows are disposed of at Lake Michigan dumping grounds, necessitating about a 30-mile round-trip tow.

The river-straightening operations described are under the direction of the Chicago Department of Public Works, Richard W. Wolfe, commissioner. The contractor is the Great Lakes Dredge & Dock Company, Chicago, Ill.

Chicago River Reverses Flow

Heavy rain on April 1 caused reversed flow in the Chicago River for about an hour. No excess pollution was discovered at the intake cribs of the water supply.

Welding Worn Rail Ends in Track, Canadian Pacific Railway

Rail Ends Built Up by Oxyacetylene Process on Mountain Divisions With Heavy Grades and Curves

THE USE of the welding process in building up battered and worn rail ends at rail joints is a new departure in railway track maintenance, and such work was carried on during 1928 on the 125-mile mountain subdivision of the Revelsloke division, on the western lines of the Canadian Pacific Railway. In this first year the oxyacetylene process was used for 3,088 joints on 100-lb. rail. For 1929 it is proposed to use an electric arc-welding machine on the 100-lb. rails between Winnipeg and Fort William.

On this mountain subdivision, between Field and Golden, B. C., the main features are grades aggregating 98 out of a total length of 125.7 miles. These grades are 1 and 2.2 per cent, and helper engines are operated on both passenger and freight trains. Curvature runs as high as 10 deg. The whole subdivision was laid with 100-lb. rails in 1923, and in 1925 it was found that on the pusher grades the rail joints were already sufficiently battered to necessitate renewing some rails on the sharper curves. Each succeeding year the situation has become aggravated, and in 1928 it was decided to increase the life of the rail by building up the battered joints by welding.

A special gang of seven men was organized for this work, and the equipment of the gang was as follows:

Four gas regulators complete with 50-lb. and 3,000-lb. pressure gages and hose connections.
Four gas regulators complete with 50-lb. and 400-lb. gages and hose connections
Four welding torches, each with 7-in. and 9-in. extension tubes, eight to ten mixer and two tips.
Four lengths ¼-in. high-pressure hose 75 ft. long.
Four lengths ⅜-in. acetylene hose 75 ft. long.
Four pairs welders' goggles.
Four lenses for goggles.
Three lenses clear cover for goggles.
Four pairs welders' mitts.
Four spark lighters.
500-lb. ¼-in. steel welding rods having 3½ per cent nickel.
Four machinists' hammers.
Four flatters.
Twelve 1-in. cold chisels.
Eight 1½-in. hot chisels.
Four straight-edges 30x2x¾ in.
One hacksaw with twelve blades.
Two 10-lb. sledgehammers with handles.
Four hammer handles.
Four punches with initial, A, B, C and D respectively, letters ¾ in. high.
One grinder with foot-power attachment.
Four cab cushions.

Instructions were issued regarding the performance of the work, and the general procedure was about as described below. The roadmaster marked joints to be built up and arranged for building up on main line end-batter in excess of 3/64 in., the welding gang being under his direction while on his territory.

Methods of Work—Instructions prepared stated that the straight-edge must be used before welding is started, to determine whether the joint is low or not. If the joint proves to be low, the straight-edge must be used on one rail only, overhanging the other rail only sufficiently to obtain the desired information. Before commencing

the weld, any loose metal or laps should be removed by flowing off; these are readily detected by quick heating on the first application of the torch, the loose metal being at a red heat before the main body of the metal shows any color. The weld should be started at the joint and worked back far enough to take out the batter or depression. The battered head of the rail is to be melted at least 1/8 in. in depth before applying any new metal. The flame should be as nearly neutral as possible, a slight excess of acetylene being allowable to insure that the flame is not oxidizing; the length of a proper welding flame is approximately three times its diameter. As the weld is finished, a larger amount of acetylene may be used to give a slight skin hardening to the metal.

The metal in the welding rod is readily overheated, a condition which would ruin the metal on the surface of the molten pool. In order to reduce the formation of oxide, the end of the rod should not be removed from the pool, but the end of the rod should be melted away by the radiated heat from the torch rather than by the torch flame. Great care must be taken that any slag or scum formed in the molten pool is not trapped in the molten metal. If this occurs, it is necessary to flow off the metal so far deposited and start the weld again. The batter overflow at gage side of the rail head to be built up must be removed either by flowing off with the torch or by cutting with a hot chisel previous to starting the weld. If the batter overflow is heavy, it will be economical to use the cutting torch, but after using the torch care must be taken to remove oxidized metal.

As the building up of the joint progresses, the built-up metal must be shaped with a machinist's hammer. Hammering the joint while hot improves the grain of the metal in the weld, and for this reason the joint should be well hammered, preferably when at dull red heat. The completed joint must be left slightly high, the amount to be determined by experience averaging 1/8 in. so as to allow for subsequent deflection under traffic. If the weld is too hot to allow passage of a train without damage to the joint, it may be quenched with water, but always after such quenching the joint must be heated up again and allowed to cool naturally. This procedure should be resorted to only in case of emergency. After the weld is completed the end of rail must be trimmed off with a chisel, care being taken that severed metal does not remain between the rail ends. Under no circumstances must the welding torch be applied to the angle bars or to any part of the rail beyond the ends of the angle bars.

Foremen in charge of welding keep a record of the number of joints built up, the amount and kind of metal and the amounts of oxygen and acetylene used by each operator, reporting this information to the roadmaster on a prescribed form. Each operator on completing a joint marks the rail with his letter punch on the opposite side of head from the gage side and over the outside bolt hole. The position of the initial indicates the type of welding metal used. The work was commenced on June 11 and terminated on Nov. 10, with 3,088 joints welded. It was carried on under maximum traffic conditions, train movements reaching as high as two per hour. Although it is too early to make a definite pronouncement as to the general result, it is regarded as satisfactory. It is hoped to obtain at least two years' additional life out of the rails thus treated, and with the experience gained during 1928 it is confidently expected that the result of the 1929 program will be considerably better.

Owing to the physical characteristics of the territory and the nature of the welders' employment, vision being much restricted by sharp curvature, it was essential that the safety of the men be amply insured. This was provided by setting out flagmen and was emphasized by a train order issued to all except first-class trains daily, outlining the limits within which the gang was working and requiring such trains to be under control.

In planning for this work it was decided to use the oxy-acetylene method and to train men from the maintenance department. Six section men were selected by the roadmaster and transferred to headquarters shop for instruction in welding, which they obtained by practicing on rails in the yard under the supervision of the mechanical department's welders. After three weeks' practice of this nature they were considered sufficiently competent to undertake work in the field, further experience being obtained under actual working conditions. The gang was organized as follows: four welders and two helpers, with a track foreman in general charge.

This foreman was later replaced by an expert welder who became available from outside sources and who assumed complete charge of the work. He was responsible for the safety of the gang, directed and supervised the actual welding, marked and prepared joints to be treated and kept a record of work done and all material received. One of his most important duties was to see that a regular supply of gas was maintained. The gas cylinders were distributed by hand car. The two helpers attended to the flags and torpedoes, notified the welders of the approach of trains, assisted in moving gas cylinders, prepared joints ahead of the welders and tightened bolts in joints after welding. The work of preparing the joint included trimming off with a chisel all loose metal and cleaning off all rust, grease and oil.

Letters to the Editor

Design of the Foshay Tower

Sir—*Engineering News-Record* of March 7 presents an article by Mr. Magney on the Foshay Tower, at Minneapolis, Minn., and some supplementary information may be of interest.

The type of interior columns was adopted for three reasons: (1) because they presented a section which easily met the requirements of practically equal bending moments in each direction, due to wind; (2) because the application of the wind stresses in the girders to the columns was direct and simple, and (3) because they presented an easy solution of erection difficulties.

The type of wall columns also was adopted not only because they met the requirements for wind and easy erection but because the distance between the inside of the flanges was constant for the necessary range of weights for the 14-in. H-beams. This made it possible to connect the spandrel beams to the inside of the flange and maintain them the same distance from the wall line, keeping the columns centered from the bottom to the top. This had two advantages: (1) it reduced the space in the room ordinarily occupied by the column when the spandrels are connected to the outside of the flange; (2) it eliminated the usual wall column offsets with their costly splice material.

Where reducing load and wind conditions made it possible to decrease the column to the 12-in. section with constant outside dimension, the columns were kept on the same center and the spandrels were connected to the outside of the flange, maintaining them in practically the same relation

to the wall line, the splice between the 12-in. and 14-in. H-beams being symmetrical. These wall columns, which sloped ⅜ in. to the foot, were milled normal to their axis, except that at the second floor, where they changed from sloping to vertical, the milled joint bisected the angle of slope.

A pair of beams purporting to be a typical spandrel section is shown in Fig. 6. This condition existed only at the basement and second floors, the typical floors having a single beam for each main spandrel. The "double" columns in the east foundation wall have an H-section riveted to the inside flange, the combined section resisting a large bending moment caused by earth pressure of a 30-ft. retaining wall. These walls were reinforced horizontally between columns.

In reciting the fiber stresses permitted by the Minneapolis building ordinance the article states: "For combined wind, dead and live loads, the stresses used were 22,500 and 24,000 lb. per sq.in." The 22,500 lb. was used for the columns, being a 50 per cent increase over the maximum permitted for dead and live load. The 24,000 lb. was used for the beams, being 33⅓ per cent increase. The reduction of the percentage of increase for the beams was due to the partial fixation of the beams under dead and live load, due to the stiff end connections.

As to the interior wind-bracing connections, the beams used had parallel flanges, and as the webs were thin it became necessary for maximum efficiency of the connection in developing the top half of the couple to transmit the beam flange stress into the web connection angle of the beam. This was accomplished by using an angle or cut channel connecting directly between the beam flange and the web angles. As the design was predicated on beams with parallel flanges, it was not necessary to bend these channels or angles to fit and the combination of these rolled beams with this connection constitutes a cheap and efficient wind-bracing girder. The writer worked up a set of these connections ranging from approximately 30,000 ft.-lb. resisting moment to 700,000 ft.-lb. with an increment of about 25,000 ft.-lb., the resisting moment of beam and connections being approximately equal. A cheaper but less efficient connection would be a cut rolled section for the lower gusset.

As the spandrel beams were riveted to the flanges of the sloping columns, the vertical axis of the beams was parallel to the wall slope. In the upper part of the building, where the wind considerations were negligible, this accounts for approximately 20 per cent of the design fiber stress. In the lower stories, where the wind was the principal factor in the design of the beams and connections, this position of the spandrels had little effect on their proportioning and any disadvantages accruing were offset by the direct connection to the columns and the elimination of weakening beveled fillers.

In the wind analysis, each line of five interior columns with four bays, and each line of five wall columns with four bays considered as a cantilever bent, was designed to take its proportion of wind pressure, it being impractical to design the wall columns to take all the wind because of the small corner columns which were offset at the second floor. Among other peculiar conditions incident to this design was one that required the building to be considered free standing above the footing, so far as earth pressure was concerned. Also that at any time excavations might be made to the boiler-room floor level, 43 ft. below grade, on any or all sides of the building, thus eliminating the balancing earth pressures due to the 30- and 43-ft. retaining walls.

As these walls were reinforced horizontally between the columns acting as beams, there were enormous computed reactions at the basement floor. Owing to the unbalanced conditions just mentioned, due to the small dimensions of the building and the fact that there were numerous holes in the floor, it was advisable to carry these reactions to the outside walls with horizontal trussing in the basement floor. This was the principal reason for the diagonal bracing in the basement floor, the wind being a secondary consideration. The wind-bending moments were not eliminated entirely from the boiler-room columns, as they have an induced moment due to the bending moments in the basement story columns.

Where the wall columns change from inclined to vertical, at the second floor, the horizontal component of the column stress amounts to approximately 100,000 lb. for the middle wall columns for dead and live load, which acts outward. Due to this outward kick of the wall columns, diagonal bracing in the second floor was adopted to assure lateral stability. The bracing would be inadequate for any wind considerations at the second floor, and twisting due to wind was not an element of the design analysis. This horizontal force at the second floor due to any wall column is balanced by an equal force (except for wind which acts in the same direction for both columns) on the opposite side of the building, producing tension in the floor system. This tension is handled by bolted connections for all the second floor main girders.

The four transverse lines of ⅞-in. tie-rods in the floor framing, extending between the corner columns, were placed to maintain the small battered columns in true position and alignment, as before the concrete slabs were poured there would have been nothing to assure this alignment except the stiffness of the spandrel connections to them, and these connections were not designed for that purpose. These corner columns are battered in two directions and the normal component of the spandrel loads acts inward, causing a pressure against and is resisted by the slab and the spandrel beams as struts.

M. G. HYDE.

St. Paul, Minn.,
April 4, 1929

"Let's Be Honest About Concrete"

Sir—If drowning of concrete be evil, so also is thirst. Mr. Johnson's happy common-sense criticism of the present-day trend in the design of concrete mixes (Jan. 24, 1929, p. 128) and its application in the field are most welcome to those of us who have struggled with the swarm of inspectors crying anathema on water and tying up the whole works for an error of a sixteenth of an inch in one of the dimensions of a batch meter.

Last summer the writer wrestled over fineness moduli, water content, water-cement ratios and slumps till the sweat literally rolled off him, only to discover that while the fine aggregate was utterly unsuited to the coarse they both must be used for "business reasons." A mix was finally designed by the most approved method, the water adjusted to satisfy the most ardent advocate of dry mixtures and cylinders were cast. The contractor in his efforts to prevent honeycomb lined the forms with laborers armed with spades and bars and all manner of devices for securing a presentable surface on the finished work. The forms were stripped—and honeycomb decorated every yard of the wall. At 28 days four of the cylinders were broken, and they barely averaged 2,000 lb. per sq.in.

In the meantime the labor foreman had been making most dire predictions unless we changed our ways. In desperation we ran through a few batches to suit his specifications, which were these: "Enough sand to float the stone, six sacks of cement to the yard and water enough to make 'er quake without coming out on top." Of eight cylinders cast and broken at 28 days not one tested less than 3,000 lb. per sq.in.; one went 4,200 lb. per sq.in. and another 4,500 lb. per sq.in. The mortar was about 1 : 2 and the stone just over 4. The spaders were cut from eight to two, and thousands of square feet of forms were stripped without a blemish!

Every bulletin of the rail committee of the American Railway Engineering Association bears witness to the expert eye of the steel puddler of days gone by which has never been equaled by chemical control. Even so with concrete. When the foreman shoved his arm to the elbow in a fresh buggy of concrete and pulled up a handful he was applying a test more practical and yet more critical than any yet devised by any laboratory anywhere. Let's be honest and admit that this test is still the best!

A. F. GILMAN.
Engineer, Soo Line Railway.

St. Paul, Minn.,
March 25, 1929.

News of the Week

Chicago Diversion Case Closed Until Early in the Fall

Testimony Taken on Construction Time and Probable Amount of Diversion Required

CLOSING the Chicago diversion case until September, Special Master Charles E. Hughes heard additional testimony on both sides through the hearings of April 24, 25 and 26. That the Southwest Side sewage treatment plant, the last step in Chicago's construction program, can not be completed before October 1, 1937 was the opinion of J. C. Ruettinger, general manager of John Griffith & Sons who built most of the existing North Side plant. This exceeds by two years the estimates of witnesses appearing for the complaintant Great Lake States.

Concerning the water necessary for storm water diversion, Professor S. M. Woodward of the University of Iowa and Horace Ramey, an engineer for the Sanitary District, gave the results of joint studies.

It was assumed that (1) dry weather effluent goes into Lake Michigan, (2) during a storm the effluent and storm water go into the canal, and (3) after a storm the untreated sewage is cleared from the Chicago River via the canal. The estimate was based on 55 general storms per year, 25 heavy local storms, and 10 predicted storms which do not materialize but which cause preparatory gate operation to establish flow into the canal. This would mean a total of 90 times per year when the gates are opened to prepare for flow. Control works are assumed at Kedzie Avenue, 8 mi. from the lake.

Diversion Required

According to Mr. Ramey, this would mean an average annual flow of 4100 sec.-ft. at Lockport. Obviously the flow, in the hypothetical case, would be zero during dry weather and over 10,000 sec.-ft. preliminary to a storm. The assumption takes 40 min. preparation for rain run-off, 5.6 hr. rainfall, 3 hr. run-off, and 68 hr. clearing the polluted waters. All ordinary reversals would be prevented in the Chicago River but occasional storm water would flow from the Calumet into the Lake because of the limited capacity of the Calumet-Sag channel. Professor Woodward's testimony was substantially the same, a slightly different basis having been used.

If all effluent is to be excluded from the Lake, an additional 600 or 700 must be added to Mr. Ramey's estimate of 4100 sec.ft. This would probably mean two or three times 600, it was stated, to avoid brief reversals during a sudden drop in lake level.

The point was made by the defense that last March when flow at Lockport was cut to about 5000 sec.-ft. to relieve flood conditions on the Illinois River, reversals in the Chicago River were almost a daily occurence. Therefore, it was concluded, at least that flow is needed to prevent reversal danger.

Lake Contamination

Dr. W. A. Evans, emeritus professor of public health, New York University, and former Chicago health officer, took the stand to point out that the typhoid rate among sailors on the Great Lakes is about twelve times as high as in the cities surrounding the lakes. This was given to show the desirability of keeping sewage out of the lake waters. Captain E. A. Ebers, a Naval Reserve officer conducting training on the lakes spoke of unsanitary conditions in sewage polluted harbors. R. A. Woodhull, a trustee of the Sanitary District of Chicago, explained the financial condition of the District.

In the cross questioning of Major General Edgar Jadwin, Chief of Engineers, it was brought out that the Corps of Engineers names 5000 sec.-ft. necessary to navigation to avoid stagnation and consequent nuisance in the polluted waters.

As Mr. Hughes sails for Europe on May 1, the case will hold over till fall. During the interim both sides will prepare briefs and make such further studies as are necessary. It is expected that a little additional testimony will be taken in September after which a decision will be forthcoming.

Oldest Skeleton-Frame Building To Be Wrecked

The wrecking of the old 14-story Tacoma Building at Chicago marks the end of the first structure having the true skeleton system for its wall framing, with the masonry serving simply for a curtain or enclosure. As related by the late H. J. Burt in *Engineering News-Record* of April 17, 1924, p. 680, the wall framing on the two street fronts consisted of cast-iron columns with cast-iron spandrel beams at each floor to support the masonry wall of the one story. On the other two sides, masonry bearing walls were used. This building, 80x125 ft., at the northeast corner of Madison and La Salle Sts., was designed by Holabird & Roche, and was built in 1887. It is now to be superseded by a 49-story building which is expected to be, for a time at least, the tallest skyscraper building in the city. 101x177 ft. in plan and 530 ft. from sidewalk to top of roof. The architects are K. M. Vitzthum & Company.

Am. Welding Society Reports Progress on Structural Welding

J. H. Edwards Awarded 1928 Miller Medal for His Achievements in Structural Welding Field

AT THE annual meeting of the American Welding Society in New York City April 24-26, 1929, the subject of welding structural steel occupied a prominent place. Several papers were presented dealing specifically with the subject, one of which was characterized as containing the best and most comprehensive information yet made available. The Structural Steel Welding Committee reported good progress on its test program which is now actively under way.

Medal Awards

Special structural interest also attaches to the presentation of the Samuel Wylie Miller gold medals inasmuch as J. H. Edwards, chief engineer of the American Bridge Company and chairman of the Structural Steel Welding Committee was given the medal for 1928 for "his energetic interest in and encouragement of this particular application of welding (steel structures) along sound and conservative engineering lines." The medal for 1927 which had not been awarded previously was given to C. A. Adams, professor of electrical engineering at Harvard, first president of the American Welding Society and continuously the director of its Bureau of Welding, in recognition of his distinguished services to the industry. The presentation of these first two medals was unusual in that Mr. Miller, the donor, did not live to see the awards although he had previously approved them. Mr. Miller was consulting engineer of the Union Carbide & Carbon laboratory and the medal to be awarded annually during Mr. Miller's lifetime was to be given "for any meritorious achievement which in the judgment of the Board of Trustees has contributed conspicuously to the advancement of the art of gas fusion welding and cutting or the art of electric arc fusion welding and cutting." At the suggestion of F. M. Farmer, chairman of the medal committee, it was recommended to the Board of Directors that the medal be continued in perpetuity as a memorial to its original donor and the Board of Directors subsequently voted that this should be done.

F. T. Llewellyn of the U. S. Steel Corporation was re-elected president of the society and all of the officers of the Bureau of Welding were retained in office for another year.

During the first morning of the meeting, a symposium on "How to Organize and Operate an Industrial Welding School" was presided over by C. A. McCune, director of research, American Chain Company, Inc., Bridgeport, Conn. The training and qualification of welders is a major problem of the industry and many schools have been started recently.

In a paper on "Physical Properties of Butt Welds" by G. Lobo, Westinghouse Electric & Mfg. Company, results were given of an investigation under way as a part of a program of tests planned to study the different variables which enter into the making of butt welds. In addition to the investigation a study of three of these variables, namely thickness of plate, scarf angle and the use of single or double V joints. Conclusions reached were that (1) 45 deg. is the best angle of bevel for a joint, the strength decreasing with the angle; (2) a single V-joint is stronger than a double V; and (3) the strength of welded joints increases up to at least a 1-in. thickness of plate. Although a 45 degree single V joint was determined as being the best joint so far as strength was concerned, it was pointed out that economic factors sometimes dictate the use of other types for cases where strength is not the main factor. Discussion brought out that many in the industry believe that the 30-deg. bevel is better. Discussion also revealed the fact that studies are under way both at the Massachusetts Institute of Technology and at Pittsburgh University looking to the method of stress transfer by fillet welds and the paths of stress distribution in the parent metal. At M.I.T. the work is being done by the polarized light method using celluloid plates "welded" by a special solution containing ground celluloid and having the properties of a glue. The studies at Pittsburgh are being made with steel.

Welding Design Data

A paper on "High Pressure Distribution of Manufactured Gas by the Aid of Welded Pipe Lines," given by C. M. Hendry, of E. L. Phillips & Company, described the construction procedure used in laying a considerable mileage of line on Long Island. Andrew Vogel of the General Electric Company, presented a paper entitled "Design of Joints for Welded Steel Structures," which brought up to date all of the welding information which the General Electric Company has compiled as a result of its very extensive tests over the past few years. This paper was characterized as containing the best information so far published on structural welding. Several tables of handbook data such as are in common use for riveted construction were included in the paper, based on the unit stresses in use by the General Electric Company. In presenting the paper Mr. Vogel stated that the development of welded steel structures has now reached a point where further progress depends largely upon the development of the details of connections and joints. A. M. Caudy, of the Westinghouse company, also outlined briefly the work on a group of welded buildings at its North Trafford works involving one and two-story structures containing approximately 100,000 sq.ft. of floor space.

Structural Welding Committee

At the meeting of the Structural Steel Welding Committee, J. H. Edwards, chairman, reported that all material for the test specimens had been rolled and shipped to the forty fabricating shops in various parts of the country where it will be fabricated. Welding operators have been qualified in thirty-two of these plants. One change was made in the program and approved by the meeting. This contemplated the omission of special inspection while the specimens were being welded at the different shops unless the shop specifically asked for it. Difficulty in securing special inspectors and the feeling that the use of the shop's regular inspectors would give a better cross section of methods of welding in industry at large led to the decision. All shops, of course, will follow the accepted procedure control. Welders must be qualified in accordance with the testing program outline which requires that two plates 11 in. wide be welded in a horizontal position, two plates 11 in. wide welded in the vertical position and two plates 11 in. wide welded overhead. Single V butt welds are used and the plates are cut into strips approximately 2 in. wide which must show a weld metal strength of 45,000 lb. per square inch.

John Fritz Medal Presented to President Hoover

The John Fritz Medal, the highest honor bestowed by the four founder engineering societies was presented to President Herbert Hoover on April 25, at the Executive Mansion in Washington. The award of the medal to Herbert Hoover was announced last year for "notable scientific and industrial achievement as an engineer, scholar, organizer of relief for war-stricken peoples and public service."

New Mexico Court Decision Affects Underground Waters

By a recent decision of the Supreme Court of the State of New Mexico, the act declaring underground waters to be public waters and subject to appropriation was declared void because the act extended by reference only, existing laws of the state, whereas, by the constitution, each section thereof as extended, must be set out in full. This defect in the law can be remedied by legislation.

The court held in this decision that this law did not ignore and over-ride vested property rights in underlying waters, but that prior appropriation to beneficial use has always been, in its jurisdiction, the basis and measure of the right to the use of artesian water, and that this law is merely declaratory of existing law.

WANAQUE RESERVOIR FILLED IN LESS THAN A YEAR

The 27,800 m.g. reservoir, built to provide a water supply for Newark, Paterson and six other New Jersey communities, filled in less than a year. The gates were closed March 23, 1928. Water flowed over the spillway on March 4, 1929, as shown by the accompanying view. The drainage area tributary to this reservoir, known as the Wanaque, is 94.4 square miles, including 4 miles of the Post Brook watershed. Adding an average of 22 m.g.d. let down the stream during the 346 days while the reservoir was filling, altogether 7,812 m.g., gives a total yield of 35,612 m.g., or a daily yield of about 1.1 m.g. per square mile of drainage area. Rainfall records for the period covered have not yet been summarized. The reservoir was built by the North Jersey District Water Supply Commission, of which Arthur H. Pratt is chief engineer and Morris Sherrerd consulting engineer.

Efficient Use of Wood Discussed at Washington Conference

Current problems in efficient use of wood were discussed at a conference of the National Committee on Wood Utilization at the Department of Commerce, Washington, on April 29. It was reported that publication of the "Manual of Wood Construction," prepared by the committee during the past year, is nearly completed. The progress of grademarking and the extension of end matching and the use of short lengths of lumber were briefly discussed. It was brought out that grademarking is extending rapidly in the field of soft woods and is nearing the position of standard practice in that field, but in the field of hard woods has found application to only a few items. The subject was discussed by Col. D. H. Sawyer, of the Associated General Contractors, from the consumer's viewpoint, and by E. E. Hunt, secretary of the committee, from the standpoint of government purchasing.

End matching of hardwoods has long been standard practice in such material as flooring, but its application to soft woods was begun only in 1912, by one mill. Some 24 mills are now end matching their soft-wood output. William F. Chew, of the Baltimore Builders Exchange, discussed the uses of the product briefly. F. E. Colesworthy, of the Crompton and Knowles Loom Works, of Worcester, speaking of dry lumber, laid stress on the user's difficulties with change of shape of wood due to varying moisture content in the marketable material.

Thomas D. Perry advocated reduction of width of saw kerf; he said that about 30 per cent of total wood production is wasted by the saw and that this might be reduced by at least 10 per cent, saving more than thirty million dollars per year. Results of the Virginia wood waste survey were outlined by J. O. Hazard, assistant forester of the state; some 28,000 carloads of wood waste per year were recorded, much of which could be utilized for pulp fiber and other products. A. R. Joyce advocated more effort to assure retail distribution of treated lumber, in order to reduce the destruction of wood by decay and insects. The present total yearly loss due to these agencies is estimated at $4,000,000.

The growing importance of small dimension lumber was discussed by Paul Kneeland. Major R. Y. Stuart of the U. S. Forest Service, and Dr. Julius Klein of the Department of Commerce, spoke on the work of their offices in relation to forestry and wood marketing.

Tall Building for Toronto

The Canadian Bank of Commerce will erect a new building in Toronto, Ont., 150x177 ft. by 500 ft. in height. It will have 35 stories above the level of the sidewalk and four stories below. About 8,000 tons of structural steel will be required, the contract for which has been awarded to the Hamilton Bridge Works, of Hamilton, Ont.

Virginia Organizes Water and Sewer Works Association

First Meeting at Richmond Listens to Dozen Papers Mostly on Water —Next Meeting in Norfolk

A WELL attended meeting at Richmond, Va., on April 25 and 26 resulted from a recent call to listen to papers and to organize a state association designed primarily for operators of water and sewage treatment plants. The constitution adopted classes operators and the technical personnel of the State Board of Health as active members, and engineers and manufacturers as associate members. Officers elected were: Chairman, W. W. Watkins, and secretary-treasurer, H. W. Snidow; respectively chemist and assistant engineer, Virginia Board of Health. Norfolk was chosen as the next meeting place.

It was because of promised additions to the small number of sewage-works in the State that sewage-works were included in the scope of the organization. This year the only paper on sewage treatment described what has been done jointly in that line by the City of Blacksburg and the Virginia Polytechnic Institute. R. B. H. Begg, professor of civil engineering at the V.P.I. told how an early plant consisting of an Imhoff tank and a contact bed had recently been replaced by a similar plant, plus a secondary settling tank and glass-covered sludge beds. Contact beds were used because of the low head available.

Water Treatment

The first of the many papers on water treatment dealt with the recent adoption of sodium hydrate to reduce corrosion (red water) in the impounded surface supply of Staunton, Va., and was presented by W. F. Day, city manager. The new supply was introduced in 1926, at a cost of $800,000, to get rid of a hard supply, and the rates were raised to carry the capital charges. The conjunction of red water and increased rates was unpleasant.

Slow sand filters at Charlottesville, built a few years ago, were described by Lee H. Williamson, consulting engineer of that city. These filters have proved satisfactory both as to efficiency and combined operating and capital charges. They indicate, said the author and other speakers, that under some local conditions, such as clear mountain supplies, slow sand filters still have a place.

After a description of the Richmond water-works, a visit was made to the local water coagulation and filtration plant, and the various pumping stations —which in succession have used water, steam and electricity as power. The old water-driven pumps were put in about a century ago.

Pre-chlorination of highly colored surface waters at Newport News and at Norfolk was described by E. F. Dugger, general manager of the water commission, Newport News, and W. W. Watkins, chemist, at Norfolk. In both cases, pre-chlorination reduces the requisite amount of alum and is otherwise beneficial.

A paper on chlorinated copper as a coagulant, successfully used for some months at Elizabeth City, N. C., and recently put on trial at Mobile, Ala., with promising results, was read by L. H. Enslow, research engineer, Chlorine Institute. Particulars of the Elizabeth City installation were given by L. L. Hedgepeth, superintendent of filtration there. The chemical is supplied by a dry-feed machine. Tentative endorsement of this chemical, on the strength of laboratory studies, was given by E. S. Hopkins, principal sanitary chemist, Baltimore filtration plant, and F. O. Baldwin, superintendent of filtration, Richmond.

Summing up on the topic, "Hard Spots, Cracks and Mud Balls in Filters," R. W. Fitzgerald, superintendent of purification, Alexandria, proposed as preventatives, thorough coagulation and sedimentation, prechlorination and high-velocity washing; as remedies, scraping, skimming, and sand removal and washing.

How to take care of filter-rate controllers, gages and the like was outlined by Richard F. Wagner, director of water, Lynchburg. H. E. Miller, engineer North Carolina Board of Health, Raleigh, said that owing to the need of attention in this respect he got the filter manufacturers to send a representative to his state who spent 3½ months inspecting and adjusting such apparatus, which has given scarcely any trouble since. Suggestions regarding filter plant operating records were presented by Wellington Donaldson, of Fuller and McClintock, New York City. The relative uselessness of records unless summarized, deductions made and followed, was stressed. The final paper on water treatment was by R. J. Leveque, superintendent filter plant, Fredericksburg, who dealt with cleaning coagulation basins and length of filter runs, with special reference to a plant in operation about two years.

Committee on Safety of Dams

American Engineering Council has recently completed the formation of its committee on legislation pertaining to the safety of dams. The personnel of the committee is as follows: Gardner S. Williams, consulting engineer, Ann Arbor, Mich., chairman; L. F. Harza, consulting hydro-electric and hydraulic engineer, Chicago, Ill.; Prof. Charles Gilman Hyde, consulting hydraulic and sanitary engineer, and professor of sanitary engineering at the University of California, Berkeley, Calif.; W. P. Creager, vice-president and chief engineer of the Northern New York Utilities Company, Watertown, N. Y.; and W. S. Lee, vice-president and chief engineer of the Duke Power Company, Charlotte, N. C.

John D. Isaacs, Former Southern Pacific Engineer, Dies

John D. Isaacs, consulting engineer of the Southern Pacific Railway Company, who retired from active service on June 1, 1923, died at his home in San Francisco on April 26. Mr. Isaacs was born in Richmond, Va., Oct. 6, 1848, and after graduation from the University of Virginia entered the service of the Southern Pacific Ry. as a draftsman March 1, 1875. In 1890 he became acting superintendent of bridges and buildings, and a year later assistant engineer, maintenance-of-way. In 1906 Mr. Isaacs was appointed consulting engineer for the Harriman Lines, and in 1913, after the dissolution of the system, was retained by the Southern Pacific Company as consulting engineer.

Mr. Isaacs did not confine his interests and activities to purely railway matters, although some of the important developments of railway engineering, such as the use of the taper rails, originated with him. He was one of the pioneers in the development of the moving picture camera and first proposed the use of rifled pipe for the transporting of heavy California oils.

Standardization of railway structures, now so generally adopted throughout the country, had its inauguration chiefly through the efforts of Mr. Isaacs on the Southern Pacific Ry. He also was one of the early advocates of tonnage rating for locomotives, and took an active interest in the development of locomotive and railway-car improvements.

Notable structures built under Mr. Isaacs' direction are the Coos Bay drawbridge, the reinforcement of the Pecos River viaduct, the construction of the lift bridge over the Willamette River at Portland, Ore., and the Berwick drawbridge over the Atchafalaya River, involving the deepest caisson work ever attempted for bridge piers.

At the time of his retirement Mr. Isaacs had served the Southern Pacific Railway continuously for 48 years.

West Side Grade Separation Plan at New York Revised

A tentative revision of the agreement between the City of New York and the New York Central Railroad Company for the elimination of the railroad company's tracks from the streets on the west side of Manhattan Island at New York has been submitted to the Board of Estimate by Arthur S. Tuttle, its consulting engineer. The plan includes changes in the New York Central tracks along Riverside Drive and some changes in the proposed structure to carry the West Side elevated highway over the New York Central tracks.

Pan-American Highway Congress Postponed to Aug. 16

The opening the second Pan-American Congress of Highways, to be held in Rio de Janiero, has been postponed to Aug. 16. The congress will continue until Aug. 31 and will have for its object the selection of methods and systems for the co-ordination of efforts relating to the construction, operation, maintenance and financing of highways.

New York Central Asks for Final Order on Unification

A final order authorizing and approving unification with the Michigan Central and Cleveland, Cincinnati, Chicago & St. Louis railroads has been requested of the Interstate Commerce Commission by the New York Central Railroad Company. The New York Central states that it has fulfilled the commission's order that offers be made to six short line roads to acquire their properties. As a result of negotiations with the short lines the New York Central has agreed to purchase for cash the entire capital stock of the Owasco River Railway. Terms for the acquisition of the Federal Valley Railway, Boyne City, Gaylord & Alpena Railroad and the Ulster & Delaware River Railroad are now being arbitrated. The commission has been advised that the Chicago, Attica & Southern Railroad and the Fonda, Johnstown & Gloversville Railroad have failed to reply to a request by the New York Central to submit the question of acquisition to arbitration.

Connecticut Loses Point in Water-Diversion Suit

Connecticut's motion to make the Secretary of War and the Chief of Engineers respondents in the dispute with Massachusettts over the diversion of water from the watershed of the Connecticut River was denied by the Supreme Court on April 22. In seeking to involve the Secretary of War and the Chief of Engineers in the litigation, counsel for Connecticut protested that these officers of the government had informed the Boston Metropolitan Water Supply District that the War Department would interpose no objection to the diversion of water from the Connecticut watershed.

This action by the War Department was taken upon the application of the Boston Metropolitan Water Supply Commission to divert excess waters of the Swift and Ware rivers, both of which are tributaries of the Connecticut. In stating that it had no objection to the diversion, the War Department specified that the water was to be taken out of the Ware River only and that not more than 85,000,000 g.p.d. should be diverted, and this only for the period each year from Oct. 16 to June 15. Such diversion, in the opinion of the Chief of Engineers, will have no adverse effect on the navigable capacity of the Connecticut River.

Simplified Pittsburgh Charter Bill Becomes Law

The proposed charter for the consolidated City of Pittsburgh, including the whole of Allegheny County, has been passed by the Pennsylvania Legislature and approved by the Governor. This charter is a simplified version of that abstracted at some length in *Engineering News-Record*, March 28, 1929, page 496. It retains, however, the essential and vital provisions of the original.

The fundamental concept of the whole program still remains, namely—that the new consolidated City of Pittsburgh shall embrace the entire county, with all of its existing powers, and with some additional municipal powers provided for in the charter, while the local self-government of the 122 cities, boroughs and townships within the county shall be forever assured.

To become effective the charter must be approved at a special election scheduled for June 25th. If a majority of all the votes cast in the county and at least two-thirds of the votes cast in the majority of the 122 cities, boroughs and townships involved favor the charter, it will become effective January 1, 1930. However, no incumbent officials will be disturbed in their present positions, and a new Board of Commissioners of seven members will not go into office until January 1, 1932.

Although the original, ambitious program of the Metropolitan Plan Commission has been modified by the Legislature, the commission is strongly in favor of the charter as it accomplishes the most important features. The population of the city after consolidation will be about 1,500,000, making it about the third largest in the country.

The Metropolitan Plan Commission, of which Morris Knowles, consulting engineer, is a member, has been continued for two years by act of the Legislature and will devote itself to further study for the amplification and extension of the principles which were embodied in the original draft.

Colorado River Commission Named by Utah Governor

R. R. Lyman, W. R. Wallace, W. W. Ray, all of Salt Lake City, were appointed by Governor Dern as the Utah Colorado River Commission created by enactment of the last Legislature. Mr. Wallace has been chairman of the Utah Water Storage Commission for several years and also has served as Colorado River Commissioner during the administration of Governor Dern. Mr. Lyman, of Lyman & Pack, civil and consulting engineers, has been vice-chairman of the Water Storage Commission. Mr. Ray, an attorney, has been actively identified with the policies of Utah's present administration relative to the Colorado River. The act creating the new commission specified that it consist of an engineer, a business man and a lawyer.

Grand Jury Investigation of Two Detroit Officials Denied

Twelve judges sitting in circuit court at Detroit, Mich., April 18, denied a petition for a grand jury investigation on charges against John W. Reid, Commissioner of Public Works, and Perry A. Fellows, City Engineer, of Detroit, alleging misfeasance in office because of alleged failure to control the flooding of land adjacent to Connors Creek on April 5. The petition was filed by a real estate operator who claimed that the channel of the Creek was more than half blocked by a sewer cofferdam and that due diligence was not used in preventing a break in the bank of the Creek which caused the flooding of several blocks. As a matter of fact the break which caused the flooding occurred at a point about 1,000 feet down stream from the sewer cofferdam. At least a contributory cause of the break was the recent high water in the Great Lakes and the Detroit River.

Fox Creek, which, like Connors Creek, is a tributary of the Detroit River in the low area also caused concern due to minor leaks through boat wells which have been built through the dikes on private property.

The Detroit River at Water Works Park, on April 5 was at El. 575.8 U.S.G.S. datum and rose on April 8 to El. 576.4. The April 5 elevation was probably higher than the river has ever been in April, at least since the high water in the eighties, and the highest since 1919, when on August 1 it was at substantially the same elevation. The maximum monthly mean on record for Lake St. Clair was El. 577.80 in July, 1883, corresponding to about El. 577.6 for Water Works Park gage.

Wabash Plans Trunk Line East of the Mississippi

The Wabash Railway is developing a plan for the formation of one or more independent trunk lines east of the Mississippi River, according to a petition filed by the railroad on April 29 for permission to intervene in the Interstate Commerce Commission proceeding against the Baltimore & Ohio alleging that acquisition of Western Maryland stock was in violation of the Clayton anti-trust law. The Wabash asks that the B. & O. be required to divest itself of Western Maryland stock in order that it may be utilized in the formation of an independent system by carriers designated by the I.C.C.

With reference to its plans for establishing a new competitive system in eastern territory, the Wabash states in its petition that from Toledo eastwardly, the lines of the Wheeling & Lake Erie Railway, the Pittsburgh & West Virginia Railway and the Western Maryland Railway will, upon completion of the line now under construction between Conchran's Mills and Connellsville, Pa., constitute an independent route to tidewater at Baltimore. The Wabash connects with the Wheeling & Lake Erie at Toledo.

Union Station for Omaha

By agreement between the Union Pacific and the Chicago, Burlington & Quincy, the present separate but adjacent passenger terminals of the two roads at Omaha, Neb., are to be combined and rearranged as a joint terminal for the eight railroads now entering that city, although each of the two owning roads will retain certain facilities and serve certain tenant roads. There will be sixteen platform tracks. On one side of these tracks will be the present Burlington station, enlarged and rearranged. On the opposite side the Union Pacific will erect a large new building on the site of the present structure, and this will serve the larger group of railroads. An elevated concourse will connect the two stations and will have stairways to the train platforms below. Both buildings have their ends fronting on Tenth St., which will be carried across the tracks by a viaduct. The cost is estimated at $4,200,000.

First Concrete on Large Dam

First concrete for the dam being erected by the Salt River Valley Water Users' Association, Phoenix, Ariz., on its Stewart Mountain project was poured April 18. The Stewart Mountain project is the fourth step in the Salt River Valley development, the preceding ones being the Roosevelt, Horse Mesa and Mormon Flat dams and power plants. The Stewart Mountain dam will be 180 ft. above bedrock and 1,200 ft. long over-all with a 400-ft. spillway. It is of the variable-radius arch type, with gravity section on the west end and overflow section on the east end. The reservoir to be created between the Stewart Mountain and Mormon Flat dams will have a capacity of 70,000 acre-ft. The installed capacity of the power house will be 12,000 hp.

Flood Continues at Quincy, Ill.

Flood stages of 21.5 ft. and 22.4 ft. were reached by the Mississippi River at Quincy, Ill., on April 22 and 26, the latter said to be the highest record since 22.5 ft. in 1851. This results from widespread and continual rainfall so that all tributaries were pouring water into the river. At this point the Mississippi has been above high-water stage for more than a month. Some manufacturing plants along the bank have had to shut down and work on the piers for the Mississippi River bridge has been interrupted. The South Quincy levee broke on April 24, flooding about 6,000 acres just south of the city. The South Fabius levee, about eight miles downstream, was breached a few days earlier at a point where it gave way last fall and had not been fully restored. Late in March the levees at both ends of the Indian Grave drainage district were broken and about 19,000 acres of land were flooded, causing much loss of stock, crops and farm property. Local forces have been busy raising and strengthening the levees and state troops were called out for patrol duty.

Work on Osage River Power Plant to Be Started Soon

Construction of a power plant on the Osage River near Bagnell, Mo., is to be started soon, according to the Union Electric Light and Power Company of St. Louis, the present owner of the power site. Construction of this power plant has been under consideration for a number of years and actual construction was begun by the Missouri Hydro-Electric Power Company in 1926, but was discontinued. The new company is stated to have entered into a contract with the St. Joseph Lead Company to supply it with a large amount of power.

The proposed dam will be 250 ft. long and approximately 100 ft. high, of reinforced concrete and earth fill. It will form a lake 125 miles long extending up the Osage River to Warsaw, Mo., flooding approximately 60,000 acres. The initial installation will be 160,000 hp. and provision will be made for an increase to 215,000. It is expected that a transmission line approximately 350 miles long will be built to St. Louis and to the plant of the Lead Company. The estimated cost of the work is $20,000,000 for the dam and power plant and $10,000,000 for the transmission line and substations. The work will take about two years. Contract for the work has been let to Stone & Webster.

Montreal Terminal Plans Before Canadian Parliament

Announcement was made recently in the Canadian House of Commons that the Montreal terminals situation would be tackled in a legislative way at the present session of Parliament. The legislation to be introduced proposes to authorize the Canadian National Railways to proceed with the construction and completion of the Montreal terminal stations and facilities and other railway works and improvements at or in the vicinity of Montreal to an amount not exceeding $50,000,000.

Sir Henry Thornton, president of the Canadian National Railways, also issued a statement announcing the intention of the company to proceed with the needed works as soon as the necessary appropriations were granted by the government and the plans approved. He expected work would start this summer. The plans of the company, he intimated, have been revised to some extent from the original announcement, to conform with the report made by Frederick Palmer, British engineer, who recently looked into the Montreal terminal problem at the request of the federal government.

A new station is to be built, taking in the present tunnel station. Bonaventure station will be eliminated as a passenger station. When the work is finished there will not be a level crossing on the Canadian National lines in the city. The plans include improvements in the handling of freight and the facilities for freight at the Bonaventure station will be retained and enlarged.

WASHINGTON NOTES

By Paul Wooton
Washington Correspondent

Nine-Foot Channel for Upper Mississippi—Use of Local Labor on Federal Work Urged

SUCH a good case has been made by industrial and agricultural interests before the Board of Engineers for Rivers and Harbors that none will be surprised if the report of the district engineer, advising against a further survey of the nine-foot channel project in the upper Mississippi River at this time, may be overruled.

Interests concerned with the development of the upper Mississippi feel that the demand for a waterway outlet from the Twin Cities is of sufficient promise and has such an important bearing on the agricultural situation that the least the United States can do is to make a careful survey of the possibilities of the nine-foot channel. It was contended that the district engineer was particularly superficial in his analysis of the potential movement of grain and grain products and that this trade alone would more than justify a deeper channel. The present project, which is not quite completed provides for a minimum depth of six feet. It was argued that it is in the public interest to revive the competition between the Duluth and the Minneapolis market for export grain. Material economies are seen in the operation of large tows on a nine-foot channel. Savings by this means would range from 2.30 c. to 4.41 c. per bushel.

The district engineer recommends that the success of operations on a six-foot channel be tried out before undertaking further improvement of the river. Numerous exhibits were presented to show material savings in the operations on a nine-foot channel as compared with operations on a six-foot channel. A large amount of statistics and other data were presented in an effort to prove that a very large traffic would move on the upper Mississippi if deep water is provided.

Mississippi River Board

FOR the purpose of fixing upon a comprehensive plan for utilizing and controlling the Mississippi, Senator Frazier of North Dakota has introduced a bill to create an organization to be known as the Mississippi River Board of Engineers. The membership of this board, according to the terms of the bill, will be appointed by the President and will include one Army Engineer and ten civilian engineers.

Each of the ten civilian engineers must have "designed or constructed a successful outstanding engineering undertaking" it is specified. In as far as the President finds practicable, it is also provided in the bill that each of the ten civilian engineers is to be chosen from a separate field of engineering. In this connection the following classifications are mentioned in the bill: Civil, mechanical, concrete, dredging, foundation, lock, contracting, electrical, and marine construction.

The proposed engineering board is charged specifically with the task of coordinating the improvement of the lower river with projects for the improvement of the entire Mississippi Valley. It is stated in the bill that the board shall submit to Congress for its approval the project so determined upon.

AIRPLANE VIEW OF LAFAYETTE DAM NEAR OAKLAND, CALIF.
Area involved in the slumping that occurred last fall is outlined clearly despite the diagonal cut made for roadway. Shadows at downstream toe indicate height of material there upheaved. Picture made Jan. 30, 1929, at El. 10,600 ft. by George S. Young, aerial photographic mapping, Oakland.

Use of Local Labor

THE effort made in previous Congresses to require contractors on Federal work to give preference to labor in the vicinity of the project, has been renewed in the special session in the form of a bill by Senator Walsh of Massachusetts. It is not believed likely, however, that anything can come of the legislation since both houses of Congress have indicated that they will adhere to the program of limiting the session to the farm relief bill and tariff revision. The only exceptions that it is believed will be made to this limitation will be in the case of the census and reapportionment bills.

In Senator Walsh's bill it is proposed that no employee of a contractor or subcontractor on a Federal project be required to work more than eight hours a day. Under the terms of the bill preference is given to citizens of the state or district who have had military or naval service before other local labor is considered. Citizens of other states and aliens are placed third and fourth on the eligibility list, respectively. A penalty of five dollars a day is provided for each worker hired in violation of the bill.

In addition to the opposition of some of the contractors organizations it is known that Treasury officials are not entirely in accord with the proposed legislation. In this connection, it is pointed out that there is doubt on the part of some of the Government's legal advisors as to the legality of an act that would tend to prevent free bidding of United States Citizens on Federal work. Regardless of the Walsh bill, it is believed that such legislation will continue to be manifested until the building and construction industry undertakes some means to regulate itself from within to limit the activities of the foreign bidder.

Similar to the Walsh bill, is a measure introduced by Senator Bingham of Connecticut which proposes that preference be given to domestic materials in contracts and purchases by the Army and Navy.

New York Central Objects to Syracuse Separation Plan

Standing squarely on what it has asserted as its constitutional and contractual rights, the New York Central Railroad through its attorney has filed with the Public Service Commission of New York its brief in opposition to the petition of the Syracuse Grade Crossing Commission for elimination of crossings by construction of a two-track elevated structure over the present right of way of the West Shore Railroad. The Central contends that it has a right to four tracks and to unrestricted operation of trains, that neither the law creating the Public Service Commission nor that creating the Syracuse Grade Crossing Commission gives any ground for interference with that right; and that any plan in contravention or abridgement of that right is illegal and unconstitutional and therefore must be met with disapproval from the Public Service Commission.

Engineering Societies

CALENDAR

ANNUAL MEETINGS

AMERICAN ROAD BUILDERS' ASSOCIATION, Washington, D. C.; annual meeting, Washington, May 2 and 3.

NATIONAL FIRE PROTECTION ASSOCIATION, Boston; annual convention, Memphis, Tenn., May 13-16.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia, Pa.; annual meeting, Atlantic City, N. J., June 24-28.

AMERICAN WATER WORKS ASSOCIATION, New York; annual meeting, Toronto, Canada, June 24-28.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; annual meeting, Mexico City, Aug. 26-28.

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THE NEW YORK SOCIETY OF THE PANAMA CANAL will hold its fifth annual banquet at the Hotel Astor on the evening of Saturday, May 4. The society is composed of officials and members of the engineering force who worked on the construction of the Panama Canal.

THE BALTIMORE SECTION, AM. SOC. C.E., at a meeting held on April 24, had Prof. J. Trueman Thompson of Johns Hopkins University as the principal speaker. He took as his subject, "The Use of Celluloid and Other Models in the Analysis of Complicated Structures," outlining the principles underlying the Gottschalk and Beggs methods, describing the application of these methods to specific problems, and discussing the character of investigation to which each is best adapted. The address was illustrated with lantern slides, and models and apparatus were displayed.

Personal Notes

KARL IMHOFF, noted German authority on sewage disposal, is again visiting the United States. Dr. and Mrs. Imhoff arrived in New York on April 21 and left immediately for Dallas, Tex., stopping at Charlotte, Atlanta, and New Orleans en route. Subsequent to his arrival at Dallas, he spent several days visiting sewage disposal works in Texas, and then went on to California. He will return East by way of Chicago.

L. D. HADWEN, assistant engineer, Chicago, Milwaukee, St. Paul & Pacific Railway, has returned to duty at Chicago, after four years leave of absence for a leisurely trip around the world.

CURTISS C. COLWELL, formerly assistant to the concrete engineer and bridge engineer of the Delaware, Lackawanna & Western Railroad, has recently left the employ of the railroad to accept a temporary appointment as assistant county engineer for Essex County, New Jersey.

ROBERT J. KADOW, civil and structural engineer, of Los Angeles, Calif., has recently accepted a position with the American Can Company as construction engineer on the new addition to the company's plant in New Orleans, La. Mr. Kadow previously served on the engineering staff of the Los Angeles plant addition and more recently has been in charge of the structural design on many apartment house buildings in the same city.

R. A. HART, drainage engineer, formerly secretary-manager, Western Clay Products Association, Salt Lake City, is now industrial secretary of the chamber of commerce in that city.

L. F. SIMONDS has severed his connection with the Construction Survey Company to take a position in the estimating department of the Aberthaw Company, of Boston.

RICHARD KING, of Rome, N. Y., has assumed his duties as assistant engineer with the engineering department of that city, succeeding MARTIN A. BRENNAN, who has accepted a position in the engineering department of the city of Syracuse, N. Y., where he was formerly employed.

R. L. KLOTZ, after a short period of employment with the Montclair (N. J.) Bureau of Water Supply, has returned to the tropics as chief engineer for the special committee on paving representing the Costa Rican government in the matter of sanitation and paving of the capital city of San José.

W. J. ROBERTS, formerly of Tacoma, Wash., has been appointed chief engineer of the Centralia power project, hydro-electric power unit No. 1, which the city of Centralia is building on the Nisqually River 30 miles from the city. R. F. Bullard will be assistant engineer on the hydraulic design of the same project.

Major JOHN F. CONKLIN, district engineer of the Nashville District, has been ordered to proceed to the West Point Military Academy on Aug. 24 for duty as assistant professor in the department of philosophy. Major Conklin was made assistant district engineer in 1927, but was recently appointed district engineer when the district was made a distinct division by the War Department.

GEORGE H. MCMAHON, who until February of this year was with the Kentucky State Highway Department, is now with the Arthur G. McKee Company, contracting engineers, Cleveland, Ohio. Mr. McMahon, from 1921 until 1926, was state drainage and irrigation engineer of North Dakota.

W. R. HOLWAY, consulting engineer, New York, formerly chief engineer of the Spavinaw Water Project for Tulsa, Oklahoma, and later consulting engineer to the Cuban government on water supply for the City of Santiago, left this country on April 24 for Moscow, Russia. He is to make a report on the proposed new water supply for the city of Moscow, this report being made for the Rosoff Subway Construction Company of New York City, which is negotiating with the Russian officials for this work and other construction projects in Moscow.

H. P. REIBER is now plant engineer for the Eaton Axle & Spring Company, Cleveland, Ohio, on maintenance, research and production engineering. For thirteen years he was plant engineer for the Oil Well Supply Company, Pittsburgh, Pa.

WILLIAM C. CLARK, formerly associated with J. F. Ancona, engineer of Rochester, N. Y., has opened his own office as consulting engineer in the Temple Building. Mr. Clark is a graduate of the Massachusetts Institute of Technology, and served during the World War as a captain in the Engineering Corps. Following the war he was connected with the engineering firm of Lockwood, Greene and Company of Boston, Mass.

ROBERT R. PECK, construction inspector with the Pennsylvania Department of Highways of Harrisburg, Pa. is now with the New Jersey State Highways Commission at Maple Shade, N. J. on highway construction.

Obituary

ROBERT H. ROMMEL, vice-president of the G. H. Rommel Company, building contractors of Louisville, Ky., died in that city on April 16, following a fall in which his skull was fractured. Mr. Rommel was 45 years old.

ALBERT E. PADDOCK, superintendent of construction, Utah Construction Company, in charge of construction of the dam on the Bureau of Reclamation's Sun River project near Great Falls, Mont., was killed April 20. He was struck by the body of a workman who, working on a guy wire about half way up the 240-ft. steel tower on the dam, lost his balance and fell, striking Mr. Paddock, who was seated about 60 ft. below him on the skip. Mr. Paddock served as superintendent for the Utah Construction Company in charge of construction of the Hetch Hetchy dam and also had been connected with dam construction at San Diego, Calif.

EDWARD J. RAINBOTH, for many years an outstanding figure in Canadian engineering and survey circles, died suddenly at his residence in Ottawa, Ontario, on April 25. He was in his 75th year. Western Canada owes much of its development to the late Mr. Rainboth as he was instrumental in laying out many towns and cities in the province of Saskatchewan. He went to the Northwest Territories in the early '80's and contributed much to the upbuilding of the great western country. For a number of years he was engaged as district engineer on the old Georgian Bay canal. For the past 27 years he had practised his profession privately, having served lately as consulting engineer to the Gatineau Power Company.

Construction Equipment and Materials

Old Paving Brick Size Reinstated

Because of the increased demand for an eliminated size paving brick, the Permanent Committee for Simplified Practice Recommendation No. 1, Vitrified Paving Brick, of the Department of Commerce, has recommended that the wire cut lug brick (Dunn) 3x3½x8½in. be reinstated as a standard type. This size brick was eliminated on March 20, 1925, but shipments during the past three years have gradually increased until today they represent 14.5 per cent of the total based upon the survey of the industry in 1928. By the inclusion of this size into the program it is stated that the degree of adherence to the committee's recommendation has increased from 70.1 per cent to 84.6 per cent. There are now six recognized sizes of vitrified paving bricks.

Patent on Feeding Propellers of Bucket Loaders Upheld

The United States Circuit Court of Appeals for the Third Circuit, sitting at Philadelphia, has recently rendered a decision in favor of the George Haiss Mfg. Company, New York City, in its suit against the Link-Belt Company, Chicago, for patent infringement. The court held that George Haiss, now deceased, was the first to suggest the use of feeding propellers on a bucket loader and that their use for that purpose constituted an invention. A decree was directed adjudging the patent valid and infringed. An injunction is to issue and an accounting of profits and damages will be directed by the court.

Business Notes

Dobbie Foundry & Machine Company, Niagara Falls, N. Y., has announced that it is discontinuing its present selling arrangements by which its products have been sold by the Mundy Sales Corporation, of New York City. In the future all of the company's products will be sold direct from its factory at Niagara Falls. It is said that one reason for the change is to bring the company into closer contact with its customers.

Dayton-Dowd Company, Quincy, Ill., manufacturer of centrifugal pumps, announces the appointment of the Corken Pump & Machinery Company, Oklahoma City and Tulsa, as its Oklahoma district representative.

American Structural Concrete Company is establishing a new plant in Newark, N. J., to manufacture "Tee Stone" building units, which are T-shaped, precast, reinforced-concrete slabs or planks 16 in. wide and 7 in. deep, the whole unit being of the required length to reach from the top of the foundation to the roof. The plank forms the exterior of the wall, while a rib, protruding inwardly with a furring strip cast on its edge, carries the lath and plaster, the space between that and the plank being left hollow. Patents for the construction are held by the Tee Stone Corporation, 527 Fifth Ave., New York City. Another manufacturing plant is being operated at Marlborough on the Hudson by Terry & Tench.

Lakewood Engineering Company, Cleveland, Ohio, announces the following new distributors: the George F. Smith Company, Franklin and Channing Aves., St. Louis, Mo.; the William H. Ziegler Company, Inc., Minneapolis, Minn.; the American Machinery & Supply Company, Omaha, Neb.; Stuart M. Christhilf & Company, Inc., Baltimore, Md.; the Equitable Equipment Company, New Orleans, La.; the Franklin-Dawson Company, Chattanooga, Tenn.; W. A. Kuhlman & Company, Toledo, Ohio, and the Milburn Machinery Company, Columbus, Ohio.

L. E. Gulliford, formerly general superintendent of the McMyler-Interstate Company, Cleveland, Ohio, has recently become associated with the Pulaski Foundry & Manufacturing Corporation, Pulaski, Vt., as general manager. Mr. Gulliford has also been connected with the Brown Hoisting Machinery Company, the Wellman-Seaver-Morgan Company, the McClintic-Marshall Company, the McMyler Manufacturing Company and the King Bridge Company.

Flint Structural Steel Company, Flint, Mich., announces that Robert W. Heerlein has been elected president and treasurer, E. H. Perkins vice-president and secretary, and E. M. Christensen chief engineer.

Northwest Cast Stone Association has been formed by a group of Northwestern manufacturers, with Ernest Thomas of Portland as president; G. E. Tucker, Seattle, vice-president; T. J. Schmidt, Portland, treasurer; and F. R. Zaugg, Seattle, executive secretary.

Trackson Company, Milwaukee, announces the appointment of the Thorman W. Rosholt Company, 928 South Fourth St., Minneapolis, Minn., as its distributor of tractor equipment for the McCormick-Deering tractor. The new distributor will handle the territories which are covered by the following branches of the International Harvester Company: Fargo and Grand Forks, N. D.; Winona, St. Cloud, Minneapolis and Mankato, Minn., and Eau Claire, Wis. Crawlers, loaders, shovels, cranes, bulldozers, etc., are the products which will be carried.

National Gunite Contracting Company, known formerly as Crom & Linberg, announces the transfer of its main office from Chicago to 82 West Dedham St., Boston, Mass. The company will continue to handle its Mid-Western business from its original Chicago office and also to maintain an additional Eastern sales office at 1849 Grand Central Terminal Building, New York City.

Orton Crane & Shovel Company, Chicago, Ill., announces the appointment of the Mott & McElrath Engineering Corporation, 249 West Eighteenth St., New York City, as its representative in the New York metropolitan district.

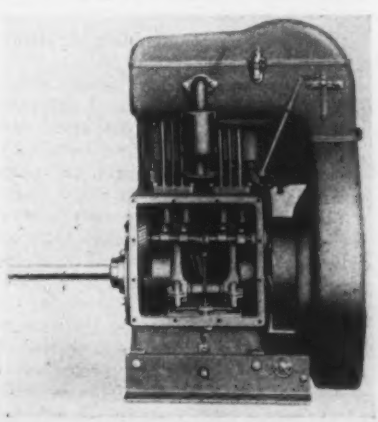
Toledo Scale Company announces the purchase of an 80-acre tract in Toledo on which new factory buildings with 250,000 sq.ft. of floor area will be built immediately.

Worthington Pump & Machinery Corporation, Harrison, N. J., announces that W. J. Denholm has been transferred from its Chicago office to the post of assistant to the manager of the Harrison works.

New Developments

A New Two-Cylinder Air-Cooled Engine

An air-cooled engine developing 6 to 10 hp. has been announced by the "New Way" Motor Company, Lansing, Mich., in a two-cylinder model. It is claimed that the new engine is the result of 23 years' experience in developing air-cooled engines for industrial and farm use. The engine is of the valve-in-head type with detachable cylinder head. Removal of a large inspection plate makes possible the examination of all moving parts. A distinctive feature of the engine is said to be the ease with which pistons may be removed and replaced through this opening. Among the standard equipment included on the



new engine are roller bearings, air governor, Eisemann flywheel magneto, Tillotson float feed carburetor and air cleaner and Lynite connecting rods.

For cooling, the flywheel is provided with a series of curved blower blades around its periphery and as it turns it creates a partial vacuum in the wheel housing. The resulting suction draws air in and down through the cylinder jackets. These air currents pass over and between the flanges at fairly high velocity, and as there is a large amount of exposed surface, the excess heat is said to be promptly disposed of, being absorbed by the air passing around the cylinders. This air is then ejected from the motor compartment by the action of the blower flywheel.

Material Tower Operates Both Cage and Concrete Bucket

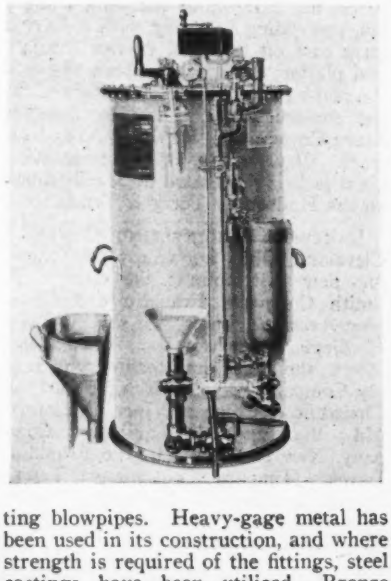
A new light-type material tower composed of pipe sections has been announced by the Lakewood Engineering Company, Cleveland, Ohio. A feature of the tower is the arrangement of the concrete bucket, which travels on the outside of the tower on a set of separate guides. Within the tower the material cage is operated independently of the bucket. The tower was designed with the idea that the contractor by using a single tower could handle both concrete and materials at the same time without

resorting to a double-compartment tower.

The bucket can be dumped at any point from top to bottom of the tower and in addition the bucket attachment, including the guides, can be installed on wood towers, silos or at other points where hoisting with an outside bucket is applicable. In commenting on the tower, the Lakewood Engineering Company states that in the past towers of this type, when they were equipped with a concrete bucket, were designed so that the bucket had to be set on the material cage. This meant moving it in and out as operations changed from concrete to materials, and also meant the resetting of the mixer each time the change was made. Furthermore, it did not give simultaneous operation of concrete and the hoisting of materials.

New Acetylene Generator for Welding and Cutting Work

A medium-pressure acetylene generator has been developed by the Oxford Acetylene Company, New York City, to be used as a stationary or portable unit in connection with either medium-pressure or low-pressure welding and cut-



ting blowpipes. Heavy-gage metal has been used in its construction, and where strength is required of the fittings, steel castings have been utilized. Bronze welding joins the generator shell and the fittings. All parts are either galvanized or sherardized according to the conditions to which they are to be subjected.

The carbide valve is rotated by a spring clock motor, which, in turn, is governed by an Oxweld diaphragm type motor-feed control. It is said that there is nothing to get out of order in the carbide feed mechanism and it should never be necessary to remove the top for cleaning or other purposes.

Pressure adjustment is made by means of a thumbscrew on the motor-feed control. Should by chance both the motor brake and relief valves fail to function, the motor locks at about 18 lb. per sq.in. pressure, thereby stopping the carbide feed. Should a broken line or leak of any kind cause the pressure to drop, the motor stops. An interference rod permits opening the water-filling cock only while the relief valves are open. The hydraulic back pressure valve is automatically drained and refilled every time the generator water is changed.

The Underwriters' Laboratories has permitted a double rating for the generator, making its rated capacity 60 cu.ft. per hour. The carbide capacity of the generator is 30 lb. and the quarter size (¼x½ in.) carbide is used. The over-all dimensions of the generator are: height, 60 in.; width, 34 in. Its weight with a full charge of carbide and water is 623 lb.

New Theodolite Features Improved Precision

A new medium-sized theodolite capable of performing work within the specifications of second order triangulation has been designed by D. L. Parkhurst, chief of the instrument division of the Coast and Geodetic Survey, for use in many operations where the ordinary engineering transit is now employed. The development of the instrument was based upon the belief that in such work as city surveys, laying out building columns, boring tunnels, setting bridge piers and in other work where precision is required, the additional cost of a precise instrument is negligible compared with the losses and delays occasioned by surveying inaccuracies.

The new theodolite is easily adjustable in the field, thus overcoming a major limitation of direction instruments. The parts are readily accessible and are interchangeable as far as possible. Standard screws are used. Provision is made for stripping and cleaning the vertical shaft and the horizontal-motion clamp. In order to prevent binding on the vertical shaft due to thermal expansion, the bearings are on two conic surfaces aligned to meet at a common point but not parallel. Thus the expansion of the metals has the same effect at the top bearing as at the bottom. This arrangement elminates the bottom thrust bearing which is necessary when a single cone is used. Tested through a temperature range of 125 deg.F., the movement was found to be free and uniform without binding.

The horizontal circle is read directly to ten seconds of arc with easy estimation to two seconds by centering a circle graduation between two parallel hairs viewed through small microscopes on each side of the instrument and reading by means of divisions on a micrometer wheel. It is stated that a ball-bearing micrometer movement has been devised to give perfect reversals without play in moving the hairs, an important step toward accuracy of readings, it is claimed. This micrometer can be readjusted after it becomes worn. The bearings of the micrometer do not require oil, a decided advantage when the instrument is used at low temperatures. Another advantage is the electric illumination of the circle graduations, making night work possible when readings are unsatisfactory by day due to fog or mirage. Special lamps with small filaments are then used as targets. The current for the instrument lamps is supplied from dry cells under the tripod.

New Publications

Sand and Gravel Equipment — GOOD ROADS MACHINERY COMPANY, INC., Kennett Square, Pa., has published a 75-page catalog containing pictures and data on modern equipment for washing and screening sand and gravel. Each piece of equipment, such as screens, bucket elevators, belt conveyors, crushers, chutes and bin gates, is considered.

The Business Side of Construction

Contracts Average 360 Million Dollars Per Month This Year

April Maintains Lead and Boosts Road Volume Which Is Still Low

For the fourth time this year the monthly value of engineering construction contracts exceeded $300,000,000, bringing the total to $1,438,000,000 which is 31 per cent more than for the four months of 1928. In millions of dollars the monthly figures have been as follows: January, 397; February, 365; March, 360; April, 316.

For the four months, gains in contract letting have been in every class with the exception of sewers (down 14 per cent) and streets and roads, where the drop is 42 per cent. In the latter connection, March lettings were reassuring as they amounted to $45,000,000 compared with only $60,000,000 for the preceding three months. Road lettings for the month exceeded $1,000,000 in Massachusetts, Connecticut, New York, New Jersey, Pennsylvania, Virginia, Florida, Tennessee, Ohio, Illinois, Wisconsin, Michigan, Arkansas, Missouri, Oklahoma, Texas and California.

The outstanding gains of the year are in buildings of all kinds, with industrial and public buildings leading strongly. The building proportion to total contract value is 66 per cent compared with 65 per cent in 1927.

Public works contracts this year amount to 25 per cent of the total, compared with 34 per cent in 1928. Waterworks have a lead of 18 per cent over last year, while the excavation total is three times as great. Bridge work is about the same, $40,000,000 compared with $38,000,000. Federal government work is more than twice as great as last year, due chiefly to Mississippi levee work and an energetic building program. The unclassified division of construction is 2½ times as heavy as last year.

Geographically the gains have been quite even with the single exception of the Middle West, where the total is $250,000,000 for this year compared with $249,000,000 last. Percentage gains for the other sections are: New England, 18; Middle Atlantic, 40; South, 24; between the Mississippi and the Rocky Mountains, 38; Far West, 43.

The Month's gains were in New England and the Middle West, with the South almost exactly the same as in March, and other sections under the figures for that month.

New Capital Issued in March Nets Over Billion

Stocks and bonds floated in March aggregated $1,044,134,349 according to the *Financial Chronicle*. Thus, the billion a month rate continues. Of this total $98,000,000 was for municipal bonds, $321,000,000 for corporate bonds and $550,000,000 for corporate stocks. The totals for the first quarter are $239,000,000 for municipals and $2,519,000 for corporate issues, compared with 1928 figures of $354,000,000 and $1,225,000,000, respectively.

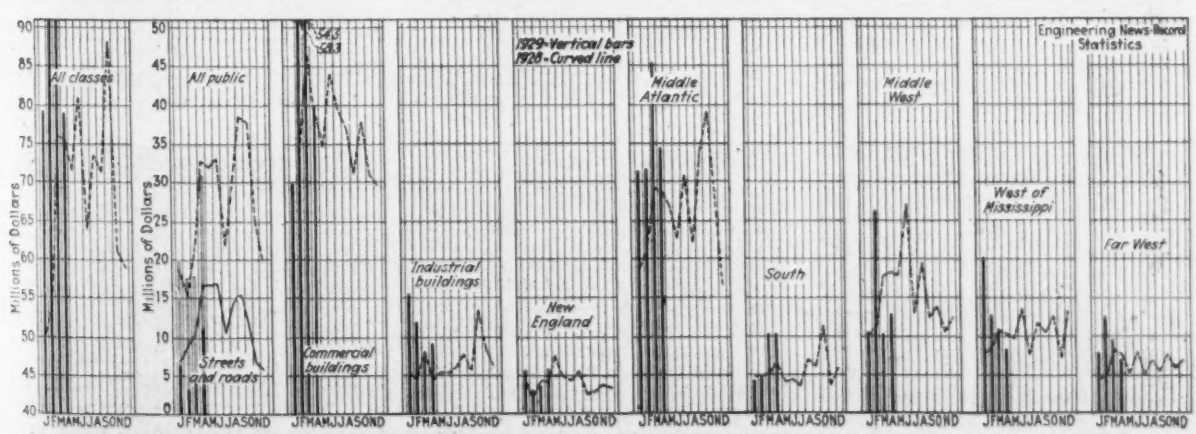
TEN LARGE CONTRACTS ANNOUNCED IN APRIL

Job and Location	Contractor and Location	Price
Hydro-electric plant, Blue Ridge, Ga.	Stevens & Wood, N. Y. C.	4,500,000
Airport, Secaucus, N. J.	W. F. Carey & Co., N. Y. C.	1,500,000
Gas line, Southwest	A. O. Smith Corp., Milwaukee	30,000,000
Aircraft factory, Baltimore	Hughes-Foulkrod Co., Philadelphia	1,250,000
Office, Chicago	John Griffiths & Son, Chicago	8,000,000 (est.)
Bank, New York	Starrett Bros., N. Y. C.	20,000,000
Subway, New York	Corson Construction Co., Brooklyn	$14,160,082
Subway, Long Island City	Atwell, Gustin, Morris, Long Island City	8,267,688
Subway, Philadelphia	Underpinning & Foundation Co., Phila.	1,919,445
Steam power plant, Holland, N. J.	W. S. Barstow, N. Y. C.	2,000,000 (est.)

VALUE OF CONTRACTS BY SECTIONS IN THE UNITED STATES AND TOTAL FOR CANADA, APRIL, 1929

Thousands of Dollars (000 omitted)

	New England	Middle Atlantic	South	Middle West	West of Mississippi	Far West	United States April, 1929	U. S. Jan. 1 to Date	Canada April, 1929
Water-works		$445	$176	$588	$948	$221	$2,378	$13,311	$200
Sewers	$153	1,866	296	2,986	969	798	7,070	24,741	150
Bridges	241	821	1,448	123	3,204	28	5,865	39,618	300
Excavations, etc.	260	34	20	511	151	100	1,076	14,729	
Streets and roads	3,567	12,133	7,388	9,018	7,773	5,247	45,126	105,178	3,286
Industrial buildings	3,947	9,543	10,570	6,949	3,583	1,424	36,016	191,272	4,865
Commercial buildings	13,904	83,057	4,374	29,765	10,885	12,009	158,994	759,178	3,450
Federal government	307	14,002	1,464	1,281	1,250	533	18,837	35,772	
Unclassified	646	16,475	16,307	384	4,403	2,632	40,847	254,355	4,036
April, 1929	23,027	138,376	42,043	51,605	33,166	27,992	316,209		16,287
March, 1929	14,671	181,316	41,640	40,835	43,805	38,059	360,326		15,641
April, 1928	17,018	114,380	24,780	73,765	41,813	30,972	302,728		11,009
Year to date, 1929	77,564	602,356	123,022	249,565	229,316	156,328		1,438,151	55,282
Year to date, 1928	65,568	417,611	89,284	249,354	162,253	109,453		1,093,523	50,722



CONTRACTS AWARDED—AVERAGE WEEK PER MONTH—TOTAL U. S. CLASSES—ALL CLASSES BY SECTIONS

Municipal Financing in May

May is expected to be a particularly heavy month for municipal financing. The largest issue will be $8,993,000 for Chicago, to be offered on May 9; Maturity is from 1930 to 1947 and the rate is 4 per cent. Seattle will offer $1,300,000 water, light and power revenue bonds not to exceed 6 per cent. The last Seattle sale was in February and the basis was 5.63. Paterson offers $2,295,000 for water, school and general improvements; average maturity 17½ years and the rates 4½, 4¾, or 5 per cent. Paterson's last sale of long time bonds was in October, 1928, when $905,000 of 4½s were sold on a basis of 4.32 and 4.33.

Municipal financing for March in millions of dollars in the last five years was 98 in 1929, 126 in 1928, 130 in 1927, 115 in 1926 and 108 in 1925.

Increasing Pressure for 5½ Days' Pay for Five Day Week

Strikes and threats of strikes in the building trades loom in contrast with the comparative quiet of a year ago. Then there was only the request for the five-day week; now there are strikes in four cities, threatened strikes in two, and a general pressure for 5½ days pay for five days work.

Strikes of April with location and demands were as follows: in New York, housewreckers and teamsters demand an increase of 10c. per hour and union recognition of the teamsters; in Kingston, N. Y., carpenters demand 25c. (to $1.25); painters 20c. (to $1.10); electricians 20c. (to $1); in Shreveport, La., carpenters and painters demand $1 per day more and the five-day week; in Washington, D. C., structural ironworkers demand an increase of 15c. (to $1.65) and five days. In the latter city, ironworkers' demands have been followed by requests for 10 per cent increases, without strike action, by tile-setters, steam-fitters, stone-masons, rubble-workers, and reinforcing-rod men.

Boston electrical workers demand an advance of 12½c. per hour (to $1.50) and the five-day week, but have not struck.

Toronto plasters, sheet metal men, lathers and carpenters (in all 2,500) demand five days, threatening strike against the 44-hour week except for emergency.

There are three important new agreements. In New York, bricklayers wages were increased $1 per day, to $15, to hold until Dec. 31. After Jan. 1 the five-day week at $15.40 per day goes for three years. In Newark, bricklayers were advanced $1.40 per day (to $15.40) with five days after July 1; carpenters to have an increase of $1.20 (to $13.20) and five days after Oct. 1. In Montreal, plasters receive an advance of 2½c. per hour (to $1.15) effective Sept. 1, contract expiring Jan. 1.

Local conditions are as follows:

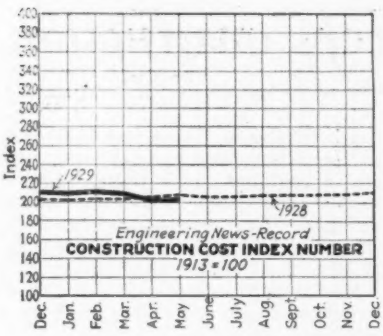
Chicago—Not so good.

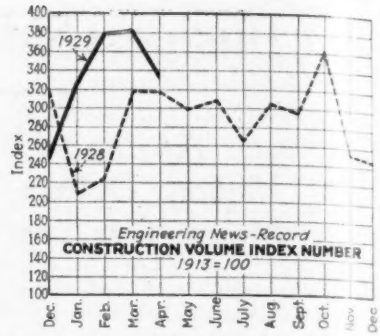
Philadelphia—Unemployment in practically all trades.

Birmingham — City Commission announces it will let as many street paving contracts as possible this spring and summer, because of unemployment.

Dallas—Surplus in all crafts, with not much improvement in view.

St. Louis—Employment increased 3½



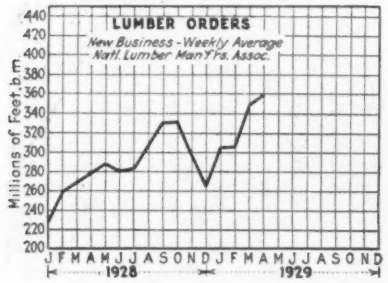


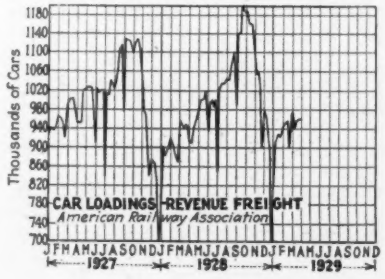
ENGINEERING NEWS-RECORD CONSTRUCTION COST AND VOLUME INDEX NUMBERS

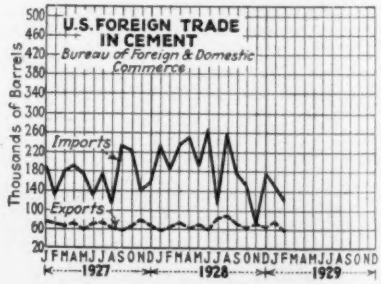
Construction Cost and Volume Index Numbers

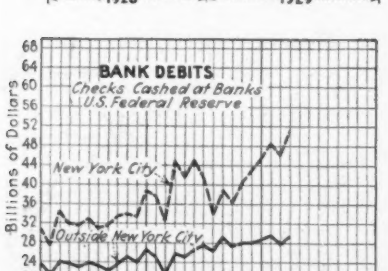
E. N.-R. Cost			E. N.-R. Volume*		
May, 1929		**205.15**	**Apr., 1929**		**332**
Apr., 1929		203.40	Mar., 1929		382
May, 1928		207.00	Apr., 1928		316
Peak June, 1920		273.80	1928 (average)		287
1928 (average)		206.78	1927 (average)		263
1913 (average)		100.00			
1928			1928		
January		203.90	January		208
February		204.65	February		225
March		204.65	March		318
April		206.40	April		316
May		207.00	May		299
June		206.15	June		308
July		206.65	July		266
August		207.29	August		306
September		207.29	September		296
October		207.71	October		363
November		209.46	November		251
December		210.16	December		244
1929			1929		
January		209.40	January		325
February		210.40	February		378
March		207.78	March		382

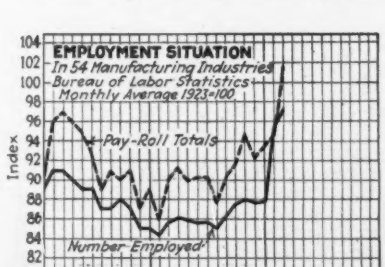
*Corrected for price change since 1913.

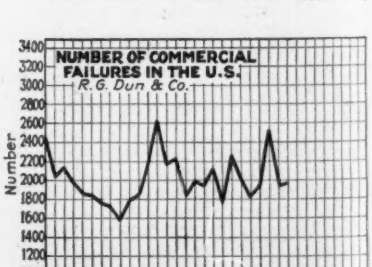

LUMBER ORDERS
New Business - Weekly Average
Nat'l Lumber Man'f'rs. Assoc.
Millions of Feet, b.m.
J F M A M J J A S O N D J F M A M J J A S O N D
1928
1929


Thousands of Cars
CAR LOADINGS - REVENUE FREIGHT
American Railway Association
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1927
1928
1929


U.S. FOREIGN TRADE IN CEMENT
Bureau of Foreign & Domestic Commerce
Thousands of Barrels
Imports
Exports
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1927
1928
1929


BANK DEBITS
Checks Cashed at Banks
U.S. Federal Reserve
Billions of Dollars
New York City
Outside New York City
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1927
1928
1929


EMPLOYMENT SITUATION
In 54 Manufacturing Industries
Bureau of Labor Statistics
Monthly Average 1923=100
Index
Pay-Roll Totals
Number Employed
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1927
1928
1929



LUMBER DEMAND—CEMENT IMPORTS AND EXPORTS—FREIGHT MOVEMENT—DEBITS TO INDIVIDUAL BANK ACCOUNTS—RELATION OF NUMBER EMPLOYED TO TOTAL PAYROLL—BUSINESS FAILURES

CURRENT BUILDING AND CONSTRUCTION TRADES WAGE RATES PER HOUR

Advances since last month are indicated by **heavy type**; declines by *italics*

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$1.25@1.40	$0.60@0.70	$0.60@1.00	$0.50	.....	$0.75@1.25	$0.25@.35
Baltimore	1.62½	1.00@1.10	1.00@1.37½	1.00	$0.65	1.00@1.25	.35
Birmingham	1.50	1.00	1.25	.50	.....	1.75	.20@.35
Boston	1.50	1.37½	1.37½	.85	1.27½	1.37½	.45@.80
Cincinnati	1.62½	1.37½	1.37½	.97½	1.37½	1.37½	.40@.7
Chicago	1.62½	1.10@1.50	1.00@1.50	.90@.96½	1.50	1.50	.90 ½
Cleveland	1.62½	1.37½	1.37½	.87½	1.10	1.50	.40@.86
Dallas	1.67½	1.12½	1.25	.40@.75	1.25	1.25	.35 @.50
Denver	1.50@1.62½	1.25	1.25@1.37½	.87½@1.00	.....	1.25	.37½@.62½
Detroit	1.56¼	1.00@1.25	1.00@1.10	.90	1.00@1.10	1.00@1.25	.37½@.60
Kansas City	1.50	1.25	1.25	.90	1.25	1.25	.35@.75
Los Angeles	1.25	1.00	1.00	.87½	.....	1.00	.35@.50
Minneapolis	1.25@1.37½	.87½@.95	.87½	.75	.....	1.00	.40@.60
Montreal	1.25	.75	.75	.40	.....	.90	.30
New Orleans	1.50	.90	1.25	.75	.80@1.00	1.25	.30@.40
New York	1.87½	1.50	1.75	1.12½	1.00@1.12½	1.75	.90½
Philadelphia	1.62½	1.12½@1.25	1.02½	.70@1.12½	1.00	1.37½@1.50	.45@.50
Pittsburgh	1.70	1.50	1.43¾@1.56¼	1.12½	.....	1.50	.40@.80
St. Louis	1.75	1.50	1.50@1.65	1.15@1.25	1.25	1.50	.40@.75
San Francisco	1.37½	1.12½	1.12½	.87½	1.12½	1.37½	.50@.60
Seattle	1.50	1.12½	1.25	1.00	1.12½	1.25	.70

per cent during month and further improvement looked for. Electrical workers, housewreckers and stonecutters demand advances. Employers ask unions to withdraw demands to prevent further decline in building. Slate and tile roofers granted 5c. (to 80c.).

Cincinnati—New contracts have increased employment over last month. Employers and craftsmen are arbitrating a request for 12½c. increase and five days.

Cleveland—New building contracts totalling $5,000,000, and much new work in sight.

Boston—Increased demand for ironworkers and carpenters.

New York—Truck drivers and yard men handling building materials in New York threaten strike action unless recognition is accorded the union by the dealers. The employers are prepared to resist the strike on grounds that unionization of the handlers would place control of the entire delivery system in the hands of a few individuals who might use this power as a key to domination of the materials industry in this locality.

Baltimore—Electricians, to the number of 200, went on strike against employment of non-union unskilled workmen on a terminal project.

Denver—Conditions in the building industry quiet. Approximately 50 per cent of the building trades are idle. Most of the work available consists of jobs under $100,000.

Montreal—Carpenters are on strike for a wage advance of 10c. per hr., to 85c. for 1929. Employers offer 80c. for a 9-hr. day.

Wage changes have been chiefly among common laborers, the national rate being 53.15c., compared with 52.9c. in April, and 55c. last May. The average common labor rate for manufacturing is 50.2c.

The average skilled labor rate remains at the April level of $1.35⅓, compared with $1.36⅔ a year ago. The average skilled rate in manufacturing is 67c.

Steel and Lumber Prices Rise; Few Other Changes

Steel and lumber prices are rising; sand, gravel, crushed stone, brick and cast-iron pipe are declining.

Steel sells at $1.95, Pittsburgh, which is 5c. above the price from October, 1928. Semi-finished material and scrap continue scarce with the price up. Heavy-melting steel scrap is $18.75 per ton, Pittsburgh, $18.50 a month ago. Although mills continue to operate at close to capacity, the higher prices are beginning to show an effect on ordering. Sales of the first quarter were 23 per cent ahead of the same months in 1928.

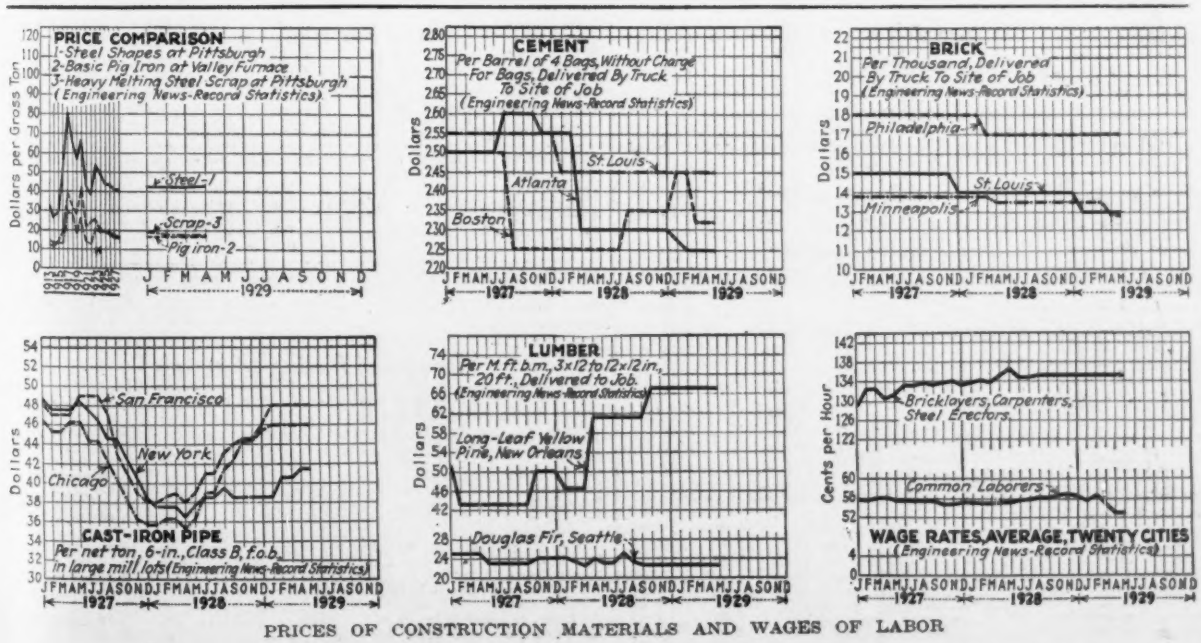
Soft-wood produced in the first fifteen weeks of 1929 totaled 4,481,693,000 b.ft., an increase over last year of 26.5 per cent. Orders booked are 25 per cent more than last year. Price advances were: Pine, $4 (to $62.50) at Chicago, and up $2.50 ($56.50) at St. Louis; fir up $2.50 ($55) at Dallas, and $1.50 ($41) at St. Louis.

Sand is down 10c. per cu.yd. (to $2.10) at Chicago; down 25c. ($1.75) at Seattle; down 10c. per ton ($1.90) at Boston. Crushed stone is down 10c. ($2) at Chicago; down 15c. per ton ($2.25) at Boston; down 10c. per ton ($1.90) at St. Louis.

Brick demand is weak, but manufacturers expect buying to reach normal volume within five weeks. Prices are the same, with no expectations of change.

Expanded metal lath advanced $2 to $3 per 100 sq.yd., except in New York, following an increase of 10c. per 100 lb. for raw material. Sheet prices are: blue annealed, $2.20; black, $2.95; and galvanized, $3.70.

Cast iron pipe is down $1 per ton (to $38) for 6-in. Class B at mill, Burlington, N. J., the same as at Birmingham. New York prices are down $1 ($40.60.)


PRICE COMPARISON
1-Steel Shapes at Pittsburgh
2-Basic Pig Iron at Valley Furnace
3-Heavy Melting Steel Scrap at Pittsburgh
(Engineering News-Record Statistics)
Dollars per Gross Ton
Steel-1
Scrap-3
Pig Iron-2
J F M A M J J A S O N D
1929
CEMENT
Per Barrel of 4 Bags, Without Charge For Bags, Delivered By Truck To Site of Job
(Engineering News-Record Statistics)
Dollars
St. Louis
Atlanta
Boston
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1927 1928 1929
BRICK
Per Thousand, Delivered By Truck To Site of Job
(Engineering News-Record Statistics)
Dollars
Philadelphia
St. Louis
Minneapolis
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1927 1928 1929
CAST-IRON PIPE
Per net ton, 6-in., Class B, f.o.b. in large mill lots (Engineering News-Record Statistics)
Dollars
San Francisco
New York
Chicago
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1927 1928 1929
LUMBER
Per M ft. b.m., 3x12 to 12x12 in., 20 ft., Delivered to Job.
(Engineering News-Record Statistics)
Dollars
Long-Leaf Yellow Pine, New Orleans
Douglas Fir, Seattle
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1927 1928 1929
WAGE RATES, AVERAGE, TWENTY CITIES
(Engineering News-Record Statistics)
Cents per Hour
Bricklayers, Carpenters, Steel Erectors
Common Laborers
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1927 1928 1929

PRICES OF CONSTRUCTION MATERIALS AND WAGES OF LABOR

Current Prices of Construction Materials

Price advances since last month are indicated by **heavy type**; declines by *italics*

Building Materials

PORTLAND CEMENT—Prices per bbl., quoted by manufacturers and dealers, delivered by trucks to contractors, *without charge for bags*. Cash discount not deducted.

	May 2, 1929	One Month Ago	One Year Ago
Atlanta	$2.25	$2.25	$2.30
Baltimore	2.65	2.65	2.65
Birmingham	2.60	2.60	2.60
Boston	2.25@2.35	2.25@2.35	2.25
Cedar Rapids (f. o. b.)	2.24	2.24	2.24
Chicago (f. o. b.)	2.05	2.05	2.05
Cincinnati (f. o. b.)	2.22	2.22	2.22
Cleveland (f. o. b.)	2.24	2.24	2.24
Dallas	2.15	2.15	2.40
Davenport (f. o. b.)	2.24	2.24	2.24
Denver	2.55	2.55	2.85
Detroit (f. o. b.)	1.95	1.95	1.90
Duluth (f. o. b.)	2.04	2.04	2.04
Indianapolis, (f. o. b.)	2.09	2.09	2.19
Jersey City	2.25	2.25	2.35
Kansas City, Mo.	**2.55**	2.22	2.50
Los Angeles	2.76	2.76	2.66
Milwaukee (f. o. b.)	2.20	2.20	2.20
Minneapolis (f. o. b.)	2.22	2.22	2.22
Montreal (f. o. b.)	1.70	1.70	1.41
New Orleans	2.65	2.65	2.50
New York	2.25	2.25	2.25@2.35
Peoria (f. o. b.)	2.22	2.22	2.22
Philadelphia	2.40	2.40	.31@2.41
Pittsburgh (f. o. b.)	2.05	2.05	2.04
St. Louis	2.45	2.45	2.45
St. Paul (f. o. b.)	2.22	2.22	2.22
San Francisco	2.41	2.41	2.41
Seattle	2.70	2.70	2.70
Toledo (f. o. b.)	2.20	2.20	2.20

Current mill-prices per barrel, in carloads, without bags, f.o.b.:

Alpena, Mich.	$1.65	Leeds, Ala.	$1.65
Buffington, Ind.	1.80	Lehigh Valley District	1.75
Clinchfield, Ga.	1.65	Mason City, Ia.	1.80
Fordwick, Va.	2.05	Mitchell, Ind.	1.90
Hannibal, Mo.	1.90	North Birmingham, Ala.	1.45
Hudson, N. Y.	1.75	Richard City, Tenn.	1.85
Iola, Kan.	1.85	Steelton, Minn.	1.85
Kingsport, Tenn.	2.05	Universal, Pa.	1.80
La Salle, Ill.	1.90	Wyandotte, Mich.	1.70

SAND AND GRAVEL—Dealers' quotations per cu.yd. delivered. Weight of sand, 1½ tons per cu.yd.; gravel, 1½ tons per cu.yd., unless otherwise specified in pounds.

	Gravel		Sand
	1½ In.	¾ In.	
Atlanta, per ton	$3.50	$3.50	$2.40
Baltimore, per ton	2.40	2.60	1.70
Birmingham (2,600 lb.)	3.00	3.00	2.65
Boston, per ton	*1.90*	*1.90*	*1.25*
Chicago	*2.00*	*2.00*	*2.00*
Cincinnati, per ton	1.90	1.90	1.60
Cleveland	2.60	2.60	2.50
Dallas	2.50	2.50	2.25@2.60
Denver (2,700 lb.)	1.80	1.80	1.30
Detroit (2,600 lb.)	3.25	3.25	2.75
Kansas City, Mo.	.....	.....	.....
Los Angeles, per ton	2.15	2.15	1.30
Minneapolis (2,800 lb.) (3,000 lb.)	2.40	2.40	*1.10*
Montreal, per ton	1.90	1.50	1.20
New Orleans (2,700 lb.) (2,500 lb.)	3.75	3.75	2.75
New York	3.25	3.25	2.00
Philadelphia, per ton	2.30@3.15	2.30@3.15	1.50@2.31
Pittsburgh, per ton	**2.55**	**2.55**	2.55
St. Louis, per ton	2.25@2.35	2.25@2.35	2.00
San Francisco (2,800 lb.),	1.75	1.75	1.50
Seattle (3,200 lb.) (2,850 lb.)	*1.75*	*1.75*	*1.75*

Note: New York gravel weighs 2,800@3,000 lb. and sand, 2,700 lb.

CRUSHED STONE—Dealers' quotations per cu.yd., delivered. Weight, 1½ tons per cu.yd., unless otherwise specified in pounds:

	1½ In.	¾ In.
Atlanta, per ton	$3.50	$3.50
Baltimore, per ton	2.75	2.85
Birmingham, Limestone	3.00	3.25
Boston, per ton	*2.25*	*2.25*
Chicago, Limestone	*2.00*	*2.00*
Cincinnati, per ton	2.50	2.50
Cleveland, per ton	2.70	2.70
Dallas	3.25	3.40
Denver, Granite (2,700 lb.)	2.50	2.50
Detroit, Limestone, per ton	3.00	3.00
Kansas City, Limestone, (2,450 l	2.00	2.00
Los Angeles, per ton	2.15	2.15
Minneapolis, Limestone (2,600 l	2.40	2.40
Montreal, per ton	2.10	2.10
New York, Limestone	3.25	3.25
Philadelphia, Limestone, per ton	2.30@3.15	2.30@3.15
Pittsburgh, per ton	3.25	3.25
St. Louis, per ton (2400 lb. per cu.yd.)	*1.90*	*1.90*
San Francisco, Trap rock (2,400 lb.)	1.65	1.65
Seattle, (2,700 lb.)	1.90	1.90

CRUSHED SLAG—Manufacturers' quotations on crushed slag in carloads, per net ton, at plant:

	1½-In.	¾-In.	Roofing	Sand
Birmingham, Ala.	$0.90	$1.15	$2.05	$0.55
Buffalo District	1.25	1.35	2.25	1.25
Cleveland, Ohio	1.30	1.30	.....	1.30
Eastern Pa. and Northern N. J.	1.25	1.25	2.00	1.25
Toledo, Ohio	1.25	1.25	1.50	1.25
Western Pennsylvania	1.25	1.25	2.00	1.25
Youngstown District	1.30	1.40	2.00	1.30

HOLLOW TILE—Dealers' quotations on hollow building tile per block, delivered to contractors in lots of 2,000 pieces or over:

	4x12x12	6x12x12	8x12x12	10x12x12	12x12x12
Atlanta	$0.075	$0.104	$0.142	$0.189	$0.21
Baltimore	.105	.....	.20	.....	.26
Birmingham	.09	.127	.174	.218	.261
Boston	.085	.11	.15	.1875	.255
Chicago	.076	.104	.142	.182	.202
Cincinnati	.074	.105	.136	.175	.205
Cleveland	.064	.088	.128	.171	.19
Dallas	.096	**.1205**	.1785	.284	.....
Denver	.0975	.135	.175	.2125	.25
Detroit	.096	.132	.18	.235	.261
Kansas City	.0525	.077	.158	.....	.242
Los Angeles	.085	.122	.175	.232	.285
Minneapolis	.0675	.0845	.131	.134	.1896
Montreal	.12	.....	.22	.....	.315
New Orleans	.086	*.118*	*.16*	.212	**.256**
New York	.0864	.1296	.162	.....	.....
Perth Amboy, N.J. (f.o.b.)	.....	.....	.....	.2388	.2956
Philadelphia	.11	.145	.22	.27	.34
Pittsburgh	.068	.....	.1175	.....	.1726
St. Louis	.078	.105	.145	.175	.21
San Francisco	.108	.156	.255	.....	.....
Seattle	.08	.11	.18	.....	.....

BRICK—Dealers' quotations, delivered, per thousand are as follows:

		Paving	
	Common	3x8¼x4-in.	3¼x8¼x4-in
Atlanta	$14.75	$38.00*	$45.00†
Baltimore	14.00	40.00	46.00
Birmingham	15.00	*30.00**	*34.00†*
Boston	17.00	43.50	*48.50*
Chicago	12.00	42.00	45.00
Cincinnati	18.00	40.00	45.00
Cleveland	14@16	33.00	36.00
Dallas	*14.50*	35.00	.....
Denver, salmon	12.00	.....	.....
Detroit	15.50	34.14	38.27
Kansas City	*14.00*	.....	.....
Los Angeles	11.00	.....	.....
Minneapolis	12.75	.....	.....
Montreal	20.33	.....	.....
New Orleans	16.50	40.00*	50.50
New York	15@16	45.00	51.00
Philadelphia	17.00	40.00	46.00
Pittsburgh	17.00	40.50	45.00
St. Louis, salmon	13.00	40.00	*42.50*
San Francisco	14.50	40.00	45.00
Seattle	14.00	50.00	55.00

*2¼x8¼x4 in. †3x8¼x4.

LIME—Dealers' quotations, delivered to job:

	Hydrated, per Ton		Lump, per Barrel	
	Finishing	Common	Finishing	Common
Atlanta	$27.50	$17.50	.....	.....
Baltimore	20.00	14.00	$2.55†	.....
Birmingham	22.00	16.00	3.00†	$2.00†
Boston	21.00	14.50	3.80*	2.90*
Chicago	17.00	15.00	17.00‡	1.50†
Cincinnati	18.00	13.20	.....	13.20‡
Cleveland	20.00	16.00	2.50†	2.50†
Dallas	20.00	.....	.....	18.00‡
Denver	32.00	23.75	3.80*	3.00*
Detroit	19.20	14.80	2.20†	2.20†
Kansas City	*16.00*	*12.50*	.....	2.75†
Los Angeles	25.00	18.00	2.85†	17.00‡
Minneapolis	25.50	21.00	.....	1.70†
Montreal	.....	19.75	.....	15.00‡
New Orleans	.....	.....	2.60†	1.60†
New York	21.00@22.00	14.00@15.00	4.00@4.10*	3.15@3.25*
Philadelphia	22.00	15.00	.....	.....
Pittsburgh	20.00	18.00	.....	.....
St. Louis	24.00	18.00	2.75†	.....
San Francisco	27.50	20.00	.....	1.70†
Seattle, paper sacks	36.00	24.00	.....	2.80†

*Per 280-lb. bbl. (net). †Per 180-lb. (net). ‡Per ton.

CONCRETE BLOCKS—Manufacturers' quotations on standard, 8x8x16-in., hollow, delivered to job, each:

Boston	$0.18@.20	Minneapolis, f.o.b.	$0.13
Brooklyn and Queens	.14@.16	New Orleans	.22
Cleveland	.16@.17	Philadelphia	.18@.25
Denver	.22	Pittsburgh	.20
Detroit	.15	St. Louis	.18

SLATE—Roofing, genuine Bangor, f.o.b., quarry, Bangor, Pa., per square:

No. 1 Clear	$10.50@$14.00
No. 1 Ribbon	9.00@ 10.25
Medium Clear	9.50@ 11.25

Road and Paving Materials

PAVING STONE—Dealers' quotations, f.o.b., in carloads or in cargo lots, for granite blocks, 4x8x4-in., dressed:

Atlanta	$3.00 per sq.yd.
Baltimore	3.00 per sq.yd.
Boston	135.00 per M.
Chicago, 5 in.	3.25@3.90 per sq.yd.
Cincinnati	110.00 per M.
Cleveland	115@120 per M
Detroit, 5 in.	3.00 per sq.yd.
Kansas City	3.50 per sq.yd.
Minneapolis, Sandstone, 4½x8x5 in.	2.80 per sq.yd.
Montreal	104.75 per M.
New Orleans	2.80 per sq.yd.
New York, 5 in., Grade 1, 30 blocks per sq.yd.	150.00 per M.
Philadelphia	125.00 per M.
St. Louis, 4x5x8 to 12 in.	3.50 per sq.yd.
San Francisco, Basalt block, 4x7x8 in.	70.00 per M.

Current Prices of Construction Materials

Road and Paving Materials—Continued

WOOD-BLOCK PAVING—Dealers' quotations, f.o.b., in carloads:

	Size of Block	Treatment	Per Sq.Yd.
Atlanta	3½	16	$2.25
Boston	3½	16	2.45
Chicago	3½	12	2.10
Cincinnati	3½	16	2.35
Dallas	3½	18	3.90
Kansas City	3½	16	2.50
Minneapolis	3½	16	2.75
Montreal	4	16	4.50
New Orleans	3½	16	2.25
New York	3½	16	2.70
St. Louis	3½	16	**2.45**

FLAGGING—Dealers' quotations, alongside dock, New York: Manhattan and Bronx, 4 ft. wide, 24c. per sq.ft.; Queens, 5 ft. wide, 26c. per sq.ft.

CURBING—Dealers' quotations: *New York*: Bluestone, f.o.b. barge, New York, 5x16 in., rough, 90c. per lin.ft., cutting charges extra. *Birmingham*: Limestone, 5x18-in., f.o.b., $1.05 per lin.ft. *St. Louis*: Class "B" straight, 5x16 in., f.o.b., *$1.00* per lin.ft.; roundings, *$1.50* per lin.ft.

ASPHALT—Manufacturers' quotations per ton in packages (350-lb. bbls. or 425-lb. drums); also in bulk in carload lots, f.o.b. points listed:

	Package	Bulk
Atlanta (Mexican)	$22.55	$18.40
Baltimore (Standard Oil, f.o.b. refinery)	21.75	17.75
Birmingham (Mexican)	27.00	23.00
Boston (Mexican)	24.00	18.00
Chicago (Texas)	24.50	21.30
Cincinnati (Kentucky Rock)	.....	12.30
Cleveland	24.00	20.00
Dallas (Texas)	*24.25*	.....
Denver (California)	35.00	.....
Detroit (Mexican)	*19.72*	*15.69*
Kansas City, Mo. (Texas)	**35.00**	.....
Los Angeles ("D" Grade, Calfornia, f.o.b., El Segundo)	18.00	12.00
Maurer, N. J. (Bermudez)	30.00	.....
Maurer, N. J. (Trinidad)	25.00	.....
Minneapolis, (Stanolind, f.o.b., Twin Cities)	24.10	19.10
Montreal (Imperial)	28.00	21.50
New Orleans (Texas)	24.00	21.00
New York (Texas)	22.50	18.50
Philadelphia (Mexican)	20.00	18.00
Pittsburgh (Standard Oil)	*16@20*	*14@16*
St. Louis (Mexican)	*21.50*	*17.50*
San Francisco, (f.o.b. refinery, Oleum, Calif.)	18.00	12.00
Seattle, ("D" grade, California, f.o.b., Richmond refinery)	19.50	13.50

ROAD OILS—Manufacturers' quotations, f.o.b., in tank cars, 8,000 gal. minimum, per gal.:

Birmingham, 40@50% asphalt	$0.0525
Birmingham, 50@60% asphalt	.0525
Dallas, 40@50% asphalt	*.055*
Dallas, 50@60% asphalt	*.055*
New York, 40@50% asphalt (at terminal)	.06
New York, 50@60% asphalt (at terminal)	.06
St. Louis, 40@50% asphalt	*.0342*
St. Louis, 50@60% asphalt	*.0357*

Iron and Steel

PIG IRON—Producers' quotations, per gross ton, f.o.b.:

Birmingham, No. 2 fdry., silicon 1.75@2.25	$15.50
Pittsburgh, basic, incl. freight ($1.76) from Valley	19.26

STRUCTURAL STEEL—Manufacturers' and dealers' quotations per 100 lb.:

	Shapes, 3 to 15-In.	Plates, ¼-In
Birmingham, large mill lots, f.o.b.	$2.15	$2.15
Chicago, warehouse, delivered	3.10	3.10
Cleveland, warehouse, delivered	3.00	3.00
Dallas, warehouse, delivered	*3.25*	*3.25*
New York, warehouse, delivered, up to 3,999 lb.	3.30	3.30
Pittsburgh, large mill lots, f.o.b., (Apr. 25, 1929)	**1.95**	**1.95**
St. Louis, warehouse, delivered	3.25	3.25
San Francisco, warehouse, delivered	3.15	3.15

BARS, CONCRETE REINFORCING—Manufacturers' and dealers' quotations on bars rolled from billets, per 100 lb. for ½-in.:

Birmingham, large mill lots, f.o.b.	$2.15
Chicago, warehouse, delivered	2.30@3.00
Cleveland, warehouse, delivered	2.25@2.44
Dallas, warehouse, delivered	3.25
New York, warehouse, delivered, over 5 tons	**2.90**
Pittsburgh, large mill lots, stock lengths, f.o.b.	2.00
St. Louis, warehouse, delivered	3.15
San Francisco, warehouse, delivered	2.25

EXPANDED METAL LATH—Dealers' quotations per 100 sq.yd., painted, delivered to job in less-than-carload lots:

Lb. per Sq. Yd.	New York	Birmingham	Chicago	St. Louis	Dallas	San Francisco
2.2	$13.50@$15.00	**$22.00**	**$20.50**	**$20.50**	**$23.50**	**$24.50**
2.5	14.50@16.00	**23.00**	**21.50**	**21.50**	**25.00**	**25.50**
3.0	16.00@17.00	**25.00**	**23.00**	**23.00**	**27.00**	**28.00**
3.4	18.00@18.50	**26.50**	**24.00**	**24.00**	**28.50**	**30.00**

WIRE REINFORCEMENT FOR CONCRETE—Manufacturers' quotations per 100 sq.ft. in carloads at mills; and dealers, delivered in lots of 10,000 sq.ft. or over; plain 4 in. by 4 in. mesh:

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh Mill	Chicago District Mill	Warehouse Delivery: New York	St. Louis	Dallas*	San Francisco*
032	22	$0.99	$1.01	$1.39	$1.30	$1.13	$1.22
049	28	1.26	1.29	1.76	1.70	1.38	1.55
068	35	1.54	1.58	2.18	2.10	1.67	1.91
093	40	1.98	2.03	2.79	2.65	2.00	2.46
126	57	2.45	2.51	3.45	3.30	2.55	3.03
153	68	2.92	2.99	4.13	3.95	3.15	.....
180	78	3.35	3.43	4.73	4.50	3.47	.....

*At warehouse.

STEEL SHEETS—Manufacturers' and dealers' quotations per 100 lb., base size

	Blue Annealed No. 10	Black No. 24	Galvanized No. 24
Chicago, warehouse, delivered	$3.35	$3.80	$4.65
Cleveland, warehouse, delivered	3.25	**3.70**	**4.55**
New York, warehouse, delivered	3.90*	4.00	4.75
Pittsburgh, large mill lots, f.o.b.	2.20	2.95	3.70
St. Louis, warehouse, delivered	3.45	**4.25**	**5.10**
San Francisco, warehouse, delivered	3.80	4.90	5.30

*Up to 3,999 lb.

WIRE ROPE—Discounts from manufacturers' list price on regular grades of bright and galvanized, Eastern Territory, New York and East of Missouri River:

	Base
Cast steel round strand rope	20%
Galvanized iron rigging and guy rope (add to list)	12½%
Galvanized steel rigging and guy rope	7½%
Plow steel round strand rope	35%
Round strand iron and iron tiller	50%
Special steel round strand rope	30%

Discount 5 points less than discount for Eastern territory: California, Oregon, Nevada, Washington, Wyoming, New Mexico, Colorado, North Dakota, Nebraska, Kansas, Oklahoma and Texas. Discount 10 points less than discount for Eastern territory: Arizona, Montana, Idaho and Utah.

RIVETS—Manufacturers' and dealers' quotations on structural rivets, round-head, ½-in., full kegs, per 100 lb.:

Chicago, warehouse, delivered	**$3.80**
Dallas, warehouse, delivered	4.50
New York, warehouse, delivered	4.50*
Pittsburgh, large mill lots, f.o.b.	3.10
St. Louis, warehouse, delivered	**3.95**
San Francisco, warehouse, delivered	5.75
Seattle, warehouse, delivered	**4.50**

*This price is for full kegs; broken kegs are $6.00 per 100 lb.

STEEL SHEETPILING—The manufacturers' base price, f.o.b., Pittsburgh, for large mill lots is $2.25 per 100 lb.

TERNE PLATE—I C, 8-lb. coating, 20x28-in., f.o.b., Pittsburgh mill:

Per package	$11.20

SHIP SPIKES—Dealers' quotations per 100 lb., black, from warehouse stocks; galvanized are about $1.75 per 100 lb. higher:

	½-In.	⅝-In.	¾-In.
San Francisco	$5.55	$5.10	$4.95
Seattle	7.75	5.65	5.50

Pittsburgh mill base in lots of 200 kegs or more, $3.00 per 100 lb.

WIRE NAILS—Dealers' quotations per 100 lb. keg, base, delivered from warehouse stocks, also Pittsburgh mill base:

Pittsburgh Mill	Birmingham	Chicago	St. Louis	Dallas	San Francisco	Montreal
$2.75	$3.30	**$3.20**	**$3.15**	$3.75	$3.35	$4.95

SCRAP—The prices following are, f.o.b., per ton, paid by dealers:

	New York Per Gross Ton	Chicago Per Gross Ton	Detroit Per Gross Ton
No. 1 railroad wrought	$12.50@$13.00	**$16.25@$16.75**	$15.00
Stove plate	8.75@ 9.50	15.00@ 15.50	10.50@ 11.00*
No. 1 machinery cast	15.00@ 17.00	17.50@ 18.00	14.00*
Machine shop turnings	7.75@ 8.00	**8.50@ 9.00**	7.75
Cast borings	7.00@ 7.25	**10.25@ 10.75**	9.25
Railroad malleable	14.00@ 14.50	19.00@ 19.50	13.00
Re-rolling rails	13.50@ 14.00	17.50@ 18.00	16.00
Re-laying rails, 56@60 lb.	23.00@ 24.00	23.00@ 25.00	.....
Heavy melting steel, No. 1	**13.35@** 13.50	15.75@ 16.25	14.50
Iron and steel pipe	11.75	12.00@ 12.50	9.00

*Net ton.

FREIGHT RATES—On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant-steel bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carload lots of 36,000 lb. or 18 tons:

Atlanta	$0.58	Detroit	$0.29
Baltimore	.31	Kansas City	.71*
Birmingham	.58	New Orleans	.67
Boston	.365	New York	.34
Buffalo	.265	Pacific Coast (all rail)	1.15†
Chicago	.34	Philadelphia	.32
Cincinnati	.27	St. Louis	.405
Cleveland	.19	St. Paul	.60
Denver	1.15†		

*Except iron or steel pipe and fittings. †Minimum weight on structurals, 60,000 lb.

Railway Materials and Supplies

STEEL RAILS—Manufacturers' quotations per gross ton, f.o.b., for large mil lots:

	Pittsburgh	Birmingham	Chicago
Standard openhearth rails	$43.00	$43.00	$43.00
Light rails, 25 to 45 lb.	36.00	34@36	34@36
Re-rolled rails	34@36	34@36	34@36

RAILWAY TIES—Dealers' quotations, f.o.b., for fair-sized orders:

		6 In. x 8 In. by 8 Ft.	7 In. x 9 In. by 8½ Ft.
New York	Long-leaf sap pine, untreated	$1.10	$1.30
	Creosoted—prices on application		
Birmingham	Southern pine, untreated	1.10	1.25
	Southern pine, creosoted	1.60	1.75
	White oak, untreated	1.40	1.78
Chicago	Oak, empty cell, creosoted	1.80	2.40
	Oak, zinc treated	1.60	2.10
	Southern pine, creosoted	1.60	2.10
St. Louis	White oak, untreated	*1.10*	*1.60*
	Red oak, creosoted	*1.45*	*1.95*
	Sap pine or cypress, untreated	.90	*1.40*
San Francisco	Douglas fir, green, untreated	.82	1.14
	Douglas fir, empty cell, creosoted	1.73	2.32
Montreal	Birch or maple, untreated	.75@1.25	.75@1.25
	Birch or maple, creosoted	1.20@1.30	1.50@1.60

Current Prices of Construction Materials

Railway Supplies—Continued

TRACK SUPPLIES—Manufacturers' and dealers' quotations per 100 lb. ...o.b., Pittsburgh mill, for large mill lots, together with warehouse prices at other places named:

	Pittsburgh	Chicago	Birmingham	St. Louis	San Francisco
Standard spikes, ⅝-in. and larger	$2.80	$3.55	$3.50	$3.65@$3.95	$3.85
Track bolts	3.80	4.55	4.50	4.65@ 4.95	4.85
Standard section angle bars, splice bars or fish plates	2.75	3.40	3.50	.....	.....

Tie plates: Price at Pittsburgh and Chicago mills, $2.15 per 100 lb.

Pipe

WROUGHT-STEEL PIPE—Discounts from manufacturers' and dealers' standard lists:

	1 to 3-In. Butt Weld		2½ to 6-In. Lap Weld	
	Black	Galvanized	Black	Galvanized
Chicago, warehouse, delivered	54%	41%	51%	38%
Cleveland, warehouse, delivered	55½%	43½%	53½%	40½%
New York, warehouse, delivered	50%	36%	45%	32%
Pittsburgh, large mill lots, f.o.b.	62%	50½%	59%	47½%
St. Louis, warehouse, delivered	49%	36%	46%	33%

CAST-IRON PIPE—Prices of U. S. Cast Iron Pipe & Foundry Co., per net ton, for bell and spigot pipe, Class B and heavier, f.o.b., on regular lots of pipe:

	4-In.	6-In. and Over
Birmingham mill	$41.00	$38.00
Burlington (N. J.) mill	*41.00*	*38.00*
Chicago	49.20	46.20
New York	*43.60*	*40.60*
Pittsburgh	49.50	46.50
St. Louis	46.60	43.60
San Francisco	51.00	48.00

Gas pipe and Class A, $3.00 per ton extra.

SEWER PIPE—Dealers' quotations, delivered, in cents per foot, for standard pipe; 6, 8 and 12-in. are single strength and 18, 24, 30 and 36-in. are double strength:

	6-In.	8-In.	12-In.	18-In.	24-In.	30-In.	36-In.
Atlanta	$0.20	$0.34	$0.75	.....	.....	.....	.....
Baltimore	.16	.30	.58	.....	$1.93	.....	$6.50
Birmingham	.25	.40	.65	$1.50	2.75	$3.90	5.83
Boston	.18	.29	.54	1.30	2.15	3.50	5.90
Chicago	.15	.28	.54	1.25	2.25	4.75	6.00
Cincinnati	.144	.224	.432	.80	1.44	2.304	4.8175
Cleveland	.18	.28	.54	1.30	2.34	4.68	7.18
Dallas	.256	.42	.794	1.70	3.00	.....	.....
Denver	.161	.23	.414	.816	1.44	.....	.....
Detroit	.18	.28	.6075	1.50	2.70	5.12	7.91
Kansas City	*.15*	.29	.52	.....	*1.80*	**3.90**	.....
Los Angeles	.21	.2825	.51	1.186	2.03	3.39	5.09
Minneapolis	.16	.25	.50	1.15	1.84	3.49	4.97
Montreal	.36	.53	.78	1.48	2.75	4.20	.....
New Orleans	.18	.30	.54	1.02	1.95	.....	.....
New York	.185	.29	.56	1.35	2.45	4.60	7.07
Philadelphia	.117	.182	.351	1.025	1.845	3.60	5.6375
Pittsburgh	.0945	.147	.2835	.85	1.53	3.024	4.8175
St. Louis	.1645	.26	.468	1.092	1.872	3.65	4.80
San Francisco	.21	.30	.54	1.26	2.16	3.60	.....
Seattle	.22	.30	.54	1.26	2.16	3.60	.....

CLAY DRAIN TILE—Dealers' quotations, delivered, per 1,000 lin.ft.:

Size, In.	New York	Birmingham	St. Louis	Dallas	San Francisco	Seattle
4	$55.00	$56.00	*$50.00*	*$63.00*	$67.50	60.00
6	112.00	105.00	112.00	*110.00*	112.50	112.00

Miscellaneous

LINSEED OIL—Dealers' quotations on raw oil, f.o.b., in 1- to 4-bbl. lots, per lb.:
New York....$0.109 Chicago....*$0.113* Minneapolis....*$0.118*

WHITE AND RED LEAD—Dealers' quotations per 100-lb. keg, base price, f.o.b., New York: White, dry or in oil, $13.75; Red, dry, $13.75; Red, in oil, $15.25.

CHEMICALS—Water and sewage treatment chemicals, round lots in the New York market:

Sulphate of aluminum, iron free, in bags, per 100 lb.	$2.00@$2.10
Sulphate of copper, in bbl., per 100 lb.	6.50@ 6.60
Soda ash, 58%, in bags, per 100 lb.	1.32@ 1.35
Chlorine, cylinders, per lb.	.05@ .08
Bleaching powder, in drums, f.o.b. works, per 100 lb.	2.00@ 2.10

MANILA ROPE—The number of feet per pound for the various sizes is as follows: ¾-in., 8-ft.; ⅝-in., 6-ft.; ½-in., 4½-ft.; 1-in., 3½-ft.; 1¼-in., 2-ft., 10-in.; 1½-in., 2-ft. 4-in. Following are dealers' quotations per pound for ¾-in. and larger, delivered in 1,200-ft. coils:

Atlanta	$0.228	Kansas City	$0.29
Baltimore	.225	Los Angeles	.25
Birmingham	.26	Minneapolis	.24
Boston	*.23*	Montreal	.245
Chicago	.22	New Orleans	.235
Cincinnati	.21	New York	.21
Cleveland	.21	Philadelphia	.24
Dallas	.20	San Francisco	.205
Denver	**.25**	Seattle	.205
Detroit	.24	St. Louis	**.215**

BUILDING PAPER—Black, in carloads, per roll of 500 sq.ft., f.o.b., producing point $1.70

SLATERS FELT—In carloads, per roll, f.o.b., producing point $0.78

ROOFING MATERIALS—Dealers' quotations, f.o.b., New York, to contractors in carloads:

Asphalt felt, per 100 lb.	$2.60
Tar felt, per 100 lb.	2.60
Asphalt coating, per gal.	.34½
Tar pitch, in 350 lb. barrels, per ton	28.00

PREPARED ROOFINGS—Dealers' quotations to contractors, in carloads, f.o.b. New York.

Single shingles, slate finish, sufficient to cover 100 sq.ft.	$6.12½
Strip shingles, 4 in 1, hexagonal shape, with Underwriters' label	5.00
Slate surfaced roofing in rolls weighing 85 to 90 lbs.	2.50

WINDOW GLASS—United inches 25, bracket size 6x8 to 10x15, single or double thickness, discount from jobbers' list (Sept. 15, 1928), at New York warehouses:
AA .....83% A .....86% B.....88%

EXPLOSIVES—Manufacturers' quotations per pound for dynamite delivered in small lots, under 200 lb.

	Gelatin 40%	Gelatin 60%		Gelatin 40%	Gelatin 60%
Atlanta	$0.22	$0.245	Los Angeles, f.o.b.†	$0.1875	$0.2225
Baltimore	.215	.2375	Minneapolis	.1925	.2125
Birmingham	.22	.245	Montreal	.195	.22
Boston	*.225*	.25	New Orleans	.195	.22
Chicago	.195*	.22*	New York	.255‡	.2775‡
Cincinnati	.22	.245	Philadelphia	.215	.24
Dallas	.1825	**.2275**	St. Louis	.215	.235
Denver, f.o.b.	.19	.2125	San Francisco	.1625	.1925
Kansas City, Mo.	.2025	.2225	Seattle	.16	.185

*Quantities above 500 lb. but less than a ton. †San Fernando Arsenal. ‡Special gelatin in case lots.

Lumber

Prices Are Per Thousand Feet, Board Measure

San Francisco—Dealers' quotations on rough Douglas fir, No. 1 common, at yards. For delivery to contractor at site of job, add $1.50 to $5 per M. ft.:

	10-16-18 and 20 Ft.	22 and 24 Ft.
3x3 and 4	$28.00	$29.00
3x6 and 8	28.00	29.00
3x10 and 12	28.00	29.00
3x14	31.00	33.00

Chicago—Dealers' quotations, f.o.b., in carloads, No. 1 Common, rough, per M. ft. b.m. For delivery to job from stock, in truckloads, add $10 per M. ft.:

	20 Ft. and Under Long-Leaf Yellow Pine	Up to 32 Ft. Douglas Fir
3x4 to 8x8	**$43.00**	$42.00
3x10 to 10x10	**50.50**	42.00
3x12 to 12x12	**62.50**	42.00
3x14 to 14x14	**74.50**	43.00

New York—Quotations per M. ft., b.m., wholesale, for long-leaf, yellow-pine timbers, No. 1 common, rough, in quantities of 35,000 ft. or more, within lighterage limits:

	20 Ft. and Under	22 and 24 Ft.
3x4 to 8x8	$43.00@$45.00	$44.00@$46.00
3x10 to 10x10	50.00@ 52.00	51.00@ 55.00
3x12 to 12x12	57.00@ 59.00	58.00@ 60.00
3x14 to 14x14	65.00@ 67.00	66.00@ 68.00

Other Cities—Dealers' quotations, delivered, No. 1 Common, rough, per M. ft:

	8x8-In. x 20 Ft. and Under				3x12 to 12x12-In. 20 Ft. and Under	
	Pine*	Fir†	Hemlock	Spruce	Pine*	Fir†
Atlanta	$47.50	.....	.....	.....	$67.50	.....
Baltimore	36.00	$50.25	$54.00	$61.00	75.00	$50.25
Birmingham	45.00	.....	.....	.....	60.00	.....
Boston	48.00	47.00	**47.25**	**47.50**	57.00	51.00
Cincinnati	38.00	49.00	47.00	47.00	42.00	53.00
Cleveland	65.00	65.00	.....	.....	65.00	65.00
Dallas	65.00	52.50	57.50	55.00	65.00	**55.00**
Denver	.....	57.00	57.00	55.00	.....	55@58
Detroit	62.50	51.50	.....	.....	68.50	51.50
Kansas City, Mo.	42.80	39.75	.....	.....	57.50	39.75
Los Angeles	.....	44.00	.....	.....	.....	38.00
Minneapolis	38.00	53.25	38.25‡	.....	58@60	53.25@54.75
Montreal	50.00	55.00	.....	.....	49.00	48.00
New Orleans	50.00	46.00	.....	44.00	67.00	63.00
Philadelphia	52.00	35.00	42.00	40.00	55.00	35.00
Pittsburgh	55@60	50@55	45@50	54@50	60@65	55@60
St. Louis	**45.50**	**39.50**	.....	.....	56.50	**41.00**
Seattle	.....	**23.00**	.....	.....	.....	22.50

	1x10 In. x 16 Ft. and Under			2x10 In. x 16 Ft. T. & Gr.	
	Pine*	Fir†	Hemlock	Pine*	Fir†
Atlanta	$60.00	.....	.....	$40.00	.....
Baltimore	56.00	$45.00	$45.00	.....	.....
Birmingham	36.00	.....	.....	43.00	.....
Boston	44.00	43.00	42.00	48.00	*$47.50*
Cincinnati	35.00	40.00	33.00	35.00	48.00
Cleveland	60.00	55.00	.....	65.00	58.00
Dallas	60.00	.....	.....	.....	.....
Denver	.....	46.00	46.00	.....	50.00
Detroit	45.00	42.00	.....	47.50	42½@45
Kansas City, Mo.	50.50	45.75	.....	44.75	36.75
Los Angeles	.....	44.00	.....	.....	57.00
Minneapolis	53.00	47.00	39.75‡	51.00	46.00
Montreal	56.00	48.00	40.00	85.00	70.00
New Orleans	43.00	40.00	.....	50.00	46.00
Philadelphia	55.00	36.50	36.00	52.00	36.50
Pittsburgh	55@60	50@55	45@50	55@60	50@65
St. Louis	*41.00*	**43.00**	**39.00**	**38.00**	**37.00**
Seattle	.....	**21.00**	.....	.....	**23.00**

*Long-leaf yellow pine. †Douglas fir. ‡F.o.b.

PILES—Dealers' quotations per lineal foot, pine, with bark on, f.o.b., New York:

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.14½	$0.18
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	.19	.23
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	.21½	.25
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	.25½	.34
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	.27½	.36
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	.35	.41